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BEHAVIOURAL RESPONSE IN THE CONTEXT OF SOCIO-ECONOMIC MICROANALYTIC SIMULATION

by

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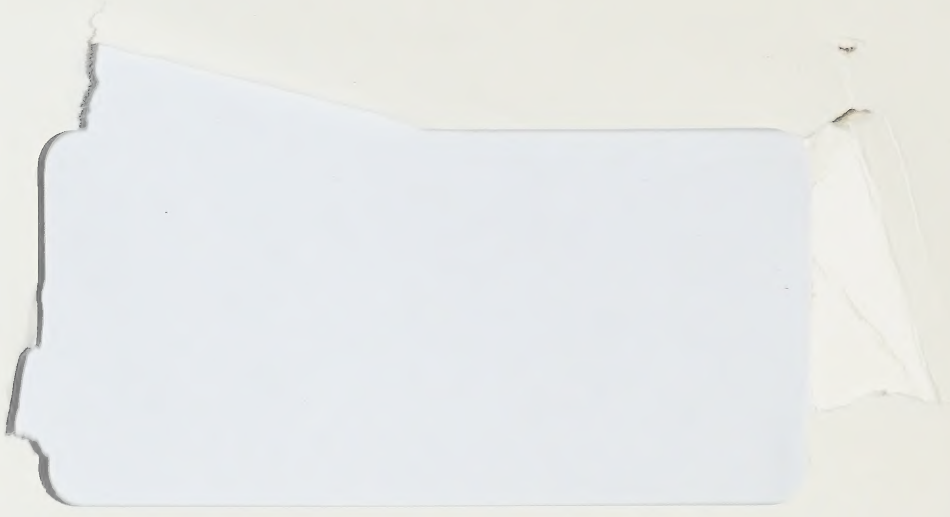

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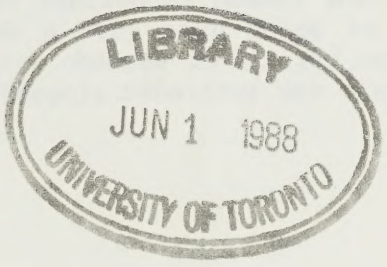

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ABSTRACT

This paper presents a critical survey of the labour/leisure choice framework and its usefulness in analyzing behavioural response to tax and social policy legislation. Micro simulation, once it moves beyond simplistic incidence analysis, must consider the behavioural response of individuals to changes which legislation induces in the constraints which individuals face. Due to its analytical simplicity, the labour/leisure framework offers a useful "first step" in modelling such behavioural response. The paper surveys the existing literature on labour supply elasticities and suggests some working assumptions. It concludes, however, on a note of caution -- namely that the single period labour/leisure choice model may be a very poor guide to the behaviour of the "working poor" when confronted with changes in tax and social policy legislation -- more elaborate models of lifecycle behaviour are clearly required .

Key Words: microsimulation, labour supply, econometrics, elasticities.

1. Introduction

This report represents an attempt "to examine, and assess for appropriateness, alternative approaches to modelling the relationship between changes in the income tax/social welfare programs and labour market activity".** The starting point for the essay is a discussion of the advantages for policy analysis of incorporating some consideration of behavioural response into analysis of the implications of programme changes (Chapter 2). The conclusion (Chapter 6) is that the first version of a behavioural socioeconomic microanalytic simulation model should probably use the simple labour/leisure choice model of behavioural response.

The labour/leisure choice model is outlined in Chapter 3, which also provides some examples of its use in the literature in recent years. As Chapter 4 makes clear, however, there are a great many theoretical, and practical, reasons to be dissatisfied with a simple model of individual utility maximization and labour/leisure choice within the time horizon of one year. Even within this simple framework, the academic literature contains a wide variety of estimates of behavioural response, even under the simplest assumptions. Chapter 5 outlines some alternative methodologies for the modelling of behavioural response to social welfare and tax legislation, as well as containing a discussion of long run strategies for modelling of behavioural response to

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**For a full statement of the terms of reference, see Appendix A.

social policy legislation.

It is not, therefore, from a point of view of complete satisfaction with the traditional labour/leisure annual utility maximization model that we suggest it as a first approach to the problem of how to incorporate behavioural response into the microanalytic simulation project of Statistics Canada. It is proposed, rather, as the most practical alternative in the immediate context of the initial construction of a socio-economic microanalytic simulation model. Just as impact analysis represented an improvement in policy analysis over the illustrative calculations previously prevalent, behavioural micro-simulation models represent an improvement over impact analysis. But the process of improvement does not stop with the first version of a behavioural micro-simulation model. Over time one can expect that more sophisticated models of household behaviour will, in turn, replace the simple labour/leisure choice framework - but that framework does represent an important step forward.

2. Microsimulation as a Modelling Problem

Micro-simulation models can, in a sense, be seen as another stage in the evolution of the technology of policy analysis. Initially, the analysis of the impacts of a policy change proceeded by means of the "illustrative example". When considering a change in, for example, tax policy the analyst would construct calculations of its effects on particular "ideal types" of people (e.g., a 38 year old married auto worker with two children, 10 and 8, living in Ontario, or a 75 year old widow living in British Columbia). These calculations have the enormous advantage that they can be readily visualized (and thereby "sold" politically) but they have the enormous disadvantage that very few people fit stereotypes exactly. Impacts are often quite sensitive to such changes in assumed circumstances as whether the individual is presumed to own their own home or not, yet the number of calculations necessary increases dramatically as complicating factors are considered.

With the development of modern computers and data bases with information on individuals or households,** it became possible to compute the impact of specified policy changes on each and every individual or household included in those data bases. Such impact analysis using micro-data offered the advantage of enabling the analyst to consider explicitly the full diversity of circumstances in which individuals find themselves, both the

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**E.g., the Survey of Consumer Finances.

obvious stereotypes and the ubiquitous "odd cases", and to calculate the relative size of impacts on each type of individual. However, impact analysis proceeds by calculating how a specified policy change will affect each individual, assuming all their characteristics remain unchanged.

Using the methodology of impact analysis, one would, for example, calculate the impact of reducing the entrance requirement for unemployment insurance from ten weeks to eight weeks by counting the number of people who now have eight or nine weeks of covered employment. Using this methodology, one would implicitly assume that nobody other than this small group would be affected by such a change in entrance requirement - i.e., it is assumed that none of those who have just ten weeks employment will decrease weeks worked to eight weeks, and no one will enter the labour force or increase weeks worked in order to qualify under the new, lower, entrance requirement. Using this methodology one might well tend to under-estimate the costs of a revision to U.I., such as that which occurred in 1971.

A behavioural microsimulation model attempts to go beyond impact analysis by building in the behavioural responses of individuals and families to changes in social and tax policy. The Canadian population displays a very wide variety of characteristics, and combinations of characteristics, and the many different policies of government interact with each other in their impacts on individuals. A micro-simulation model reflects the fact that individuals adjust to their environment and take

advantage of their opportunities, hence one cannot expect their behaviour to remain unaltered by social or tax policy changes. As a result, the costs and benefits of specified programme changes are analyzed in terms of a comparison of the pre-reform situation and the situation after individuals have adjusted to the programme change. Since individuals who change their behaviour in response to one policy change are often treated differently by other existing policies, a micro-simulation model can analyze the impact of a change in programme A on the costs of programme B - an effect which impact analysis cannot capture since behaviour is assumed to be constant.

For example, the Royal Commission on the Economic Union and Development Prospects for Canada has recently proposed the introduction of a Universal Income Security Plan (UISP). An impact analysis of UISP would calculate the effect of the proposal of a $3825 per adult guarantee level and a 20% tax rate increase on total income as implying a net $2060 increase in transfer payments for a single person who now earns $5000 for 1000 hours of work. [= 3825 - .2(5000 + 3825)] A micro-simulation model would attempt to estimate the response of the individual to these new incentives. If the individual was predicted to increase hours of work to 1200 hours, a micro-simulation model would calculate the net increase in transfer payments as $1860 [= 3825 - .2(6000 + 3825)]. Estimates of the fiscal cost of a UISP will clearly not be the same if one uses impact analysis rather than micro-simulation.

Furthermore, an increase in work effort will increase individual entitlement under the Canada Pension Plan as well as altering eligibility for other programmes. Such changes in other programme costs can be considered using a behavioural microsimulation methodology, but not using impact analysis, since impact analysis must necessarily consider programmes in isolation. The microsimulation methodology is the only practical way of attempting to keep track of the diverse implications for individuals of policy, and the interactions between policies, which characterize socio-economic reality.

The problem, however, is that the construction of a comprehensive and integrated socio-economic microsimulation model is a large and complex undertaking. Of necessity, this modelling exercise extends over many years.** Microsimulation models cannot, therefore, be constructed with the view that the best possible version is the one that runs first. In this sense, microsimulation modelling is not an occupation for an academic purist, who is convinced of the necessity to find the best possible answer for each narrowly defined question. Rather, microsimulation modelling is better conceived of as a process, in which less satisfactory modelling algorithms are continually being replaced by more satisfactory modelling algorithms and in which the total product of the model improves gradually over time.

**Over twenty years in the case of Guy Orcutt and his associates at the Urban Institute and the Institute for Survey Research.

In part, this perspective of microsimulation models as being continually subject to renovation and revision is based on the practical requirement that even early versions of the model must demonstrate some useful output. In part the continuous process of revision is necessitated by the fact that each new policy initiative which is examined with the use of microsimulation inevitably has some new aspects which require a slightly different approach than policies previously analyzed. In addition, in 1986 it is simply not the case that a consensus exists among economists on the magnitude, (and sometimes the signs) of key behavioural responses to economic incentives. It is therefore essential that microsimulation models be able to accept a variety of operating characteristics, in order to assess sensitivity of overall policy conclusions to specific assumptions as to behavioural response in the future.

The key ingredients of the microsimulation methodology are (a) the statistical data base; (b) a series of mechanical file handling and data manipulation algorithms and (c) a series of behavioural modules, which attempt to alter the characteristics of the data base over time in ways that would be similar to the behaviour of the individuals represented in the data base. File handling algorithms are important because their efficiency (or lack of efficiency) is an important factor in determining per-run costs of using the model, which must ultimately be low enough to enable a wide variety of policies to be simulated. Construction, cleaning and reconciliation of the data base is an

extraordinarily important part of the process of microanalytic simulation, and a major expense item. Indeed, initial decisions on the data base are in some senses more important than initial decisions on the method of behavioural modelling, since behavioural responses can always be modelled somewhat differently in future periods, if the data base contains the appropriate data.

Although the emphasis in the paper is on the parameters to be adopted in the behavioural modules (c), it would be remiss not to emphasize the importance of (a) and (b) at the outset. From one perspective, it is only the declining costs of (a) and (b), due to ongoing advances in information processing technology, which enable one seriously to consider trying to model the behaviour of many thousands of individuals. Just as the development of computers enabled impact analysis to supplant illustrative calculations as a tool for policy analysis, it is the cheapening of computing power which enables one to model behavioural response to policy change - and which will enable increasingly more sophisticated modelling of behavioural response.

3.0 The "Simple" Model of Labour/Leisure Choice

The plan of this chapter is to present in section 3.1 the very simple model of labour/leisure choice and individual utility maximization within one period. Although this model is extremely familiar to professional economists, and the repetition of the model may run the risk of inducing terminal boredom among some readers, still it is the model which lies behind most econometric models of the behavioural response of individuals to policy legislation. We therefore present it first, in order to fix ideas clearly before introducing the complications of sections 3.2 to 3.5 -- and also because there is a certain nostalgia value in presenting the model which was used when the analysis of labour supply was thought to be a simple problem.

Section 3.2 generalizes the model of individual utility maximization to the problem of family labour supply. Sections 3.1 and 3.2 therefore comprise what Killingsworth (1983) has at called "first generation labour supply models". Since the late 1970s econometric analysis of individual labour supply has increasingly emphasized the issue of "sample selection bias", the seminal article for which is Heckman (1979). Section 3.3 discusses the complications which this model of labour supply introduces into the "simple" labour leisure choice framework, while Section 3.4 discusses the modelling problems which arise when individuals are faced with non-linear constraints (such as a progressive income tax schedule). Section 3.5 discusses uses the labour/leisure choice framework to analyze two programmes a

guaranteed annual income programme (e.g., UISP) and unemployment insurance. We present these two cases because the first (UISP) is very easy to analyze using the labour/leisure choice framework and exhibits the strengths of this approach. However, unemployment insurance is representative of a broad class of highly complex social programmes, whose analysis using a labour/leisure choice framework is much more problematic. Section 3.6 presents a summary of the empirical literature which has at tempted to estimate the own wage, income and compensated wage effects which are such key concepts in the labour/leisure choice framework. Since there is, among analysts of the labour market, a wide range of empirical predictions one is unavoidably faced with the problem of selecting particular parameter values for income and substitution effects from among those presented in the published literature. This choice is the subject of Section 3.7.

3.1 The "Simple" Individual Labour/Leisure Choice Model

The labour/leisure choice model owes its simplicity to the strength of its underlying assumptions. It assumes that individuals derive utility from the consumption of goods and from the time spent outside paid employment. Individuals are presumed to be able to vary their hours of work at will, and to receive a constant wage per hour for their labour. It is assumed that individuals choose to work the number of hours that will generate the combination of money income and non-working time (often

loosely called "leisure") which will maximize their utility within a given year.

This simple model can be represented diagrammatically as in figure 3.1. In algebraic terms the individual maximizes equation 1 subject to equation 2a and 2b.

(1) $\text{Max } u = u(g,L)$

(2a) $P_G G \leq WH + V$

(2b) $L = T - H$

where G = goods consumption
W = wage per hour
H = hours of paid work
V = non labour income
T = total time available
L = hours of leisure

The major point in repeating this model here is that it argues that behavioural response in the labour market can be analyzed in terms of income and substitution effects. The "income" effect is the change in hours worked which is induced when an individual receives an increase in income, with wage rates unchanged. One normally expects the "income effect" of a policy change on hours of labour supply to be negative, since a higher income means an individual can 'afford' more leisure. On the other hand, if wage rates per hour rose, an individual who was at the same level of utility would tend to consume less

FIGURE 3.1

The simple Labour/Leisure Choice Model.

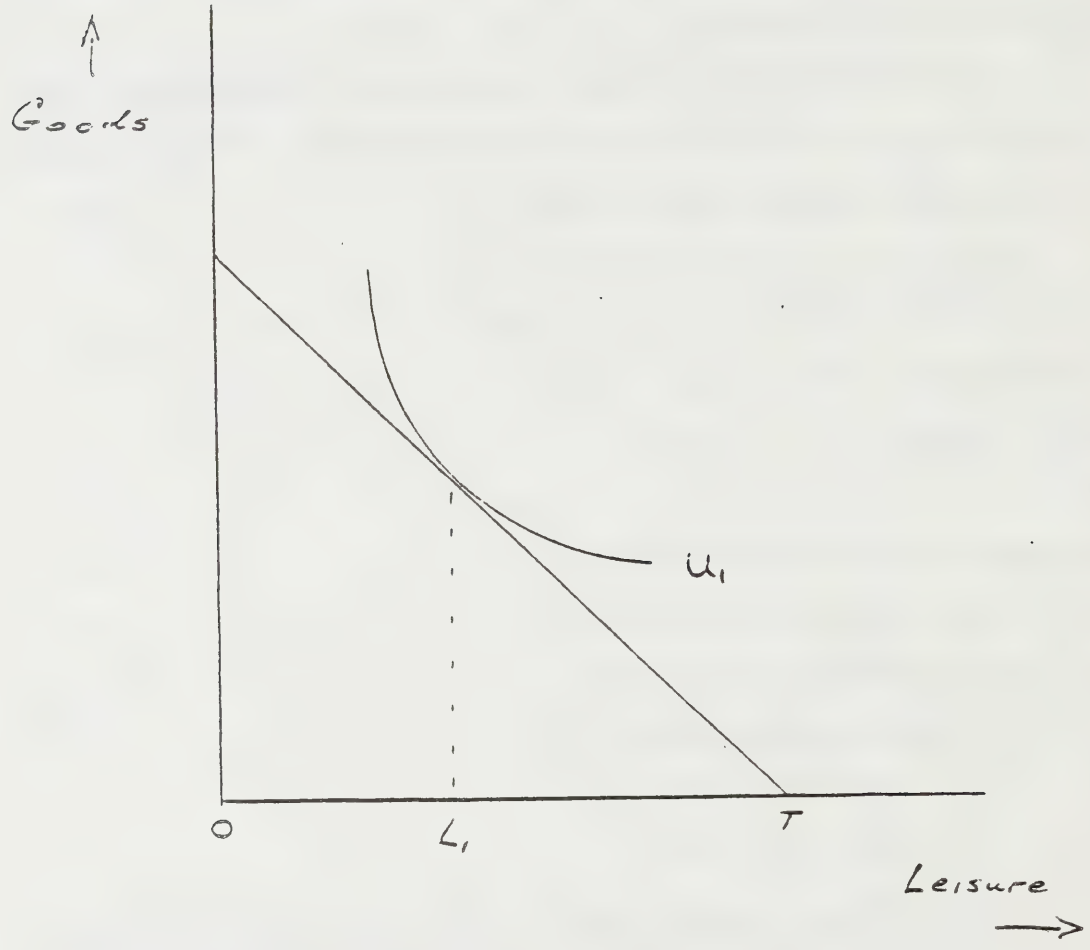
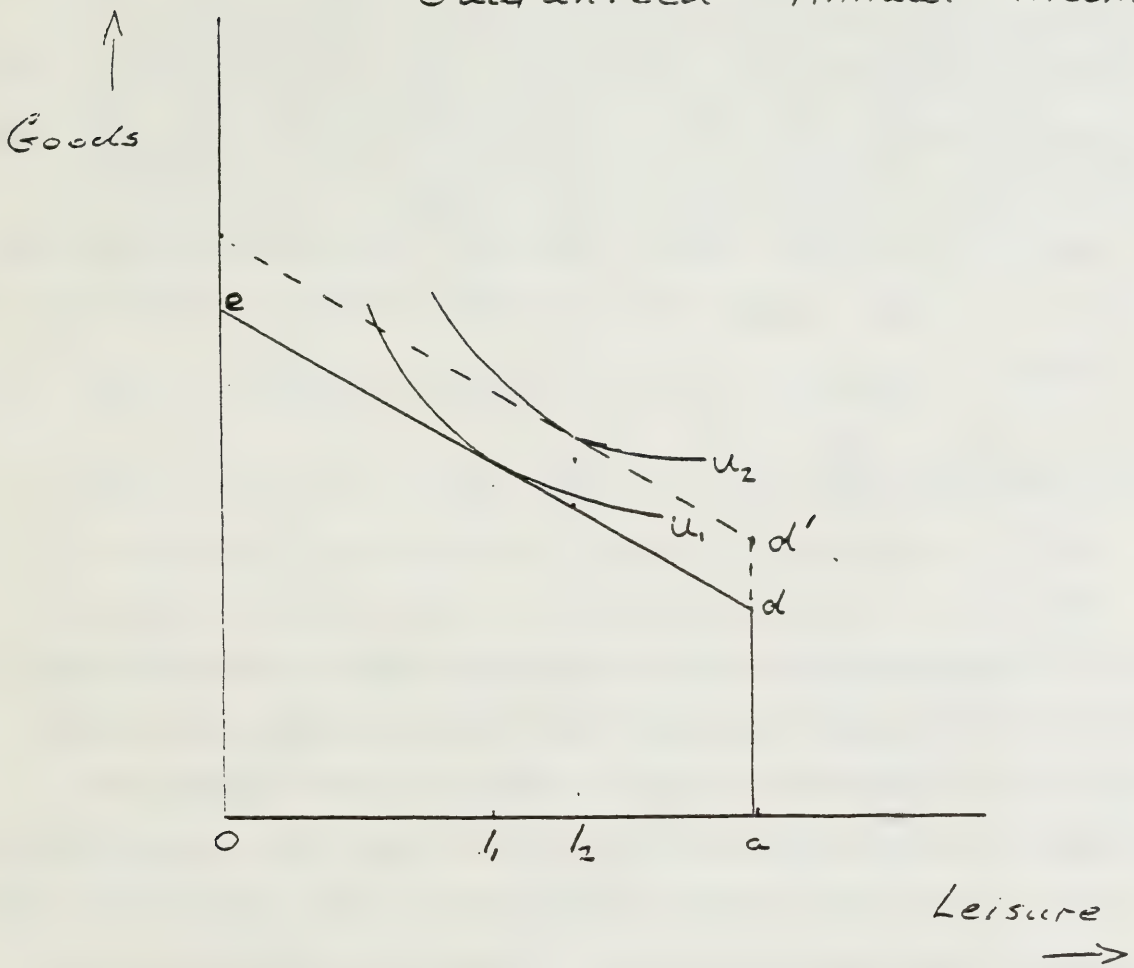


FIGURE 3.2

Labour/Leisure Choice under a Guaranteed Annual Income



leisure, since each hour of leisure is now more expensive in terms of foregone money income (the "substitution" effect). The Slutsky equation (3) breaks the total effect of a change in wages down into the "income" effect of a change in income on labour supply holding wages constant and the "substitution" effect of a change in labour supply due to a change in wages, holding utility constant.

$$(3) \quad \frac{\partial H}{\partial W} = \left(\frac{\partial H}{\partial W}\right)_{\bar{u}} + H \cdot \left(\frac{\partial H}{\partial Y}\right)_{\bar{w}}$$

From the point of view of policy analysis the major point to this model is that it argues that a social policy such as the UISP can be analyzed in terms of the differing impacts of a change in the guarantee rate (which affects labour supply via the income effect) and changes in the tax rate on total income (which entail a substitution effect). Indeed the UISP can be easily represented in a diagram such as Figure 3.2, where ad is the guarantee level and the slope of de is the after tax net wage rate per hour. Initially, the individual has utility of U_i and takes hours of leisure. A higher guarantee level (e.g., ad') will, naturally, produce an increase in utility (to U_2) and, if leisure is a normal good, an increase in demand for leisure (to l_2) - and, therefore, a corresponding decrease in labour supply.

Jump and Rea (1975: p. 55, 73-76) and Glenday and Alam (1982:8-21) have also used this simple model to analyze the

behavioural responses of individual workers to specific changes in the unemployment insurance act. Indeed, the Jump and Rea study was based on the argument that if one specified a regression equation such as (4) the coefficients B_1 and B_2 could be interpreted as equal to $\frac{\partial H}{\partial V}$ and $\frac{\partial H}{\partial W}$ respectively.

(4) $H = a + B_1 w + B_2 V + BX$

where X represents a vector of control variables.

Taking the mean of labour supply as equal to H and substituting in equation 3 one can derive the pure substitution effect. Although this econometric methodology can be, and has been, severely criticized (see below) it is the source of the empirical estimates which, in combination with the representation of the unemployment insurance system discussed in Section 3.5, underly the estimated behavioural response of individuals to unemployment insurance revision contained in Jump and Rea (1975).

More recent econometric work, e.g., Hausman (1984) uses considerably more sophisticated econometric techniques (see Section 3.4) but the fundamental perspective is unaltered. Public policy is conceived of as being decomposable into income and substitution impacts on individuals within the labour market. These impacts are summarized as elasticities. The income elasticity is defined as the percentage change in hours of labour supply for a 1% increase in income (holding wages constant). The substitution effect is measured by the "compensated" wage elasticity or the percentage change in hours of labour supply for

a 1% change in wages, holding utility constant. Following equation (3), one can express the wage elasticity of labour supply** as the sum of the income elasticity of labour supply and the compensated wage elasticity of labour supply.**

Since it is not possible to directly observe a "compensated" wage elasticity of labour supply, this crucial empirical parameter is inferred by subtraction of an estimated income effect from a total own wage elasticity of labour supply. The only unambiguous prediction of neoclassical economic theory regarding labour supply is that the compensated wage elasticity of labour supply should be positive. This magnitude is only ever empirically estimated indirectly, but its magnitude is highly important for a discussion of the labour supply impacts of alternative programme changes. It is perhaps not surprising that so much controversy surrounds estimated behavioural responses of individuals, using this methodology.

3.2 Family Labour Supply

For quite a while, there has been a concensus in labour economics that one should recognize the interdependencies in the

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**The percentage change in labour supply for a 1% change in net wages.

**In the literature, this is sometimes called the "own wage" elasticity, "total" elasticity or "uncompensated" elasticity - all of which mean the same. Mathematically, equivalent expressions for the uncompensated wage elasticity are: % change in H/% change in W = $\partial \ln H / \partial \ln W = \frac{\partial H}{\partial W} \cdot \frac{W}{H}$

allocation of time among people in the same household, and estimate "family" labour supply models. No concensus has, however, emerged on how to model the decision making processes of families.

Perhaps because family labour supply models were initially constructed as a way of analyzing labour market behaviour of women, early models simply assumed that the labour hours of husbands were set exogenously and that wives adjusted their labour hours so as to maximize family utility. Family utility was modelled as a function of total goods and leisure consumed, but the essential aspect of this class of family labour supply models is asymmetry in husband/wife labour supply effects. Although Killingsworth's characterization of this class of models as "male chauvinist" (1983:29) is perhaps excessive, these models are sequential decision-making models. Changes in the real hourly wage rate received by husbands are assumed to affect their labour supply directly, and their wives labour supply indirectly (via the income effect on family income.) Changes in the real hourly wage received by wives are assumed to have income and substitution effects on wives hours of labour supply but not to affect the labour supply of husbands. In recent Canadian literature on female labour supply, both NaKamura and Nakamura (1981) and Smith and Stelcner (1985) have adopted this underlying theoretical model.

Alternatively, one could assume that husbands and wives jointly and simultaneously decide upon hours of labour supply in

order to maximize a utility function which is defined over joint consumption of goods and leisure time of both individuals, subject to the budget constraint defined by their joint resources, and wage rates. The chief feature of this framework is the assumption that the cross wage elasticities of labour supply are symmetric -- i.e., a one percent change in the net wage rate of a husband on the labour supply of the wife has the same magnitude of impact as a one percent change in the net wage of the wife on the labour supply of the husband.** Robinson and Tomes (1985) chose this joint utility maximization framework for their analysis of female labour supply in Canada.

In addition, there are a variety of duopoly and bargaining models of family decision-making and labour supply. The choice among these models of family labour supply is not innocuous, since alternative theoretical perceptions of how families make decisions about labour supply to the paid labour market impose strong a priori restrictions on econometric estimation. As we all know from personal experience, how families make decisions is a contentious issue. Estimates of the behavioural response to social policy legislation which are derived from a microsimulation model will depend somewhat on the implicit model of internal family decision making which that socio-economic simulation model contains. One of the key early decisions to be

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** Note that the "sequential" or "male chauvinist" model of family labour supply assumes that the cross wage elasticity of a change in the wife's wage on the labour supply of the husband is zero.

made in microsimulation is the preferred model of family decision making.

At this stage of a micro-simulation project there is a good deal to be gained by simplicity, where possible. A duopoly model or joint family utility maximization would require a complicated simultaneous equation algorithm for each household. Even though it has been labelled "male chauvinist", the exogenous male hours assumption is far easier to programme in a micro-simulation model.

Due to its greater ease of programming and to its currency in the literature, I would recommend that at this stage in the micro-simulation project male labour hours (as determined by the process described in 3.6 below) be viewed as an exogenously given determinant of female labour supply.

3.3 The Sample Selectivity Bias Issue

In at least three ways Heckman's (1979) paper in Econometrica "Sample Selection Bias as a Specification Error" represented the "perfect" academic paper. In this paper Heckman (1) pointed out a fundamental flaw underlying the empirical estimates in almost all pervious research on labour supply but (2) did not require any fundamental change in the theoretical perspective which had informed such estimation, hence (3) created many person years of secure employment for academics in the reestimation of labour force behavioural equations.

The sample selection bias issue is, in fact, a pervasive one

in economics since behavioural relationships are usually estimated from samples of the population, yet individual decisions or other social processes may determine whether an individual is part of the sample. The issue initially arose in the modelling of the labour supply response of women to changes in tax rates, since the total labour supply response will be the increase in the labour supply of women who are already employed plus the increase in labour supply of women who enter the paid labour force. But the increase in labour hours from current non-participants in the labour force will depend on the change in the net hourly wage available to them, which depends on both the change in taxes and the pre-tax wage they could earn in the labour market. We know the offered wage for those who are currently employed (i.e., their actual wage) but how can we estimate the wage potentially available to those who do not now work for wages?

Heckman argued that it was inappropriate to estimate a potential wage solely from observations on the population of employees and to generalize that potential wage to the population of non workers. Workers and non workers differ, of course, in their observable characteristics (e.g., years of education or schooling). Previous studies had assumed that differences in the potential wage open to workers and non workers could be captured in a regression equation which estimated the relationship, for employed workers, between wages and observable characteristics. However, wages data do not exist for non workers, for the simple

reason that such individuals are not employed. They must, however, be different in some way from working individuals with similar observable characteristics (such as age, sex or education), since we know that they behave differently (i.e., do not work for pay). Heckman argued that the population of non workers must differ in terms of the characteristics which determine probability of labour force participation from the population of workers, and that the omission of such considerations would bias the coefficients in estimates of wage equations, i.e., that non-consideration of the determinants of labour force participation created an 'omitted variables bias'. However, he also proposed a solution -- namely that one could correct for this by including a sample selectivity bias correction term** (calculated from a probit model of the probability of participation in the labour force) in an ordinary least squares regression predicting the offered wage. In the 1980s, consideration of the sample selectivity bias issue is therefore mandatory econometric practice for all aspiring academic labour economists.

From the point of view of a socio economic microsimulation model, there are four main implications of this new emphasis on unobservable variables and "self-selection" into behavioural categories.(1) Estimates of labour force behaviour which are drawn from the 1960s and 1970s literature prior to consideration

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**Sometimes referred to in the literature as "the inverse Mills ratio".

of the sample selectivity bias issue are considered in academic circles to be increasingly suspect; (2) since the sample selectivity bias correction term is calculated from the output of a probit model (which must be estimated by maximum likelihood techniques) the computation costs of estimating labour force behaviour have increased substantially. This is likely to be a short run problem, since computing costs are rapidly decreasing and new software will soon perform the now burdensome computations automatically, but there is a short run deficit of credible econometric results on labour force behaviour. (3) The sample selectivity bias issue represents an extension, not a contradiction, of "standard" neo-classical economic theory. (4) Self selection is an issue which runs much deeper than labour force participation, since one can reasonably argue that individuals self select for higher education, or for geographic migration, or for social behaviour such as marrying or having children.

A specific example of the importance of considering sample selection bias can be found in the analysis by Glenday and Alam (1982) of the impacts of unemployment insurance. This study, (which uses the UIC/DNR microdate base) notes (p. 37) that some 52.8% of the spells of time which workers spent outside paid employment during 1974-79 do <u>not</u> result in a UI claim being established. Some 88.4% of spells without employment were preceded by spells of employment sufficient to establish an entitlement, hence for the vast majority of non-claimants "it was

a voluntary decision not to establish a claim upon losing or leaving their jobs (1982:45)".**

Consideration of the incentive effects of UI on work effort/unemployment will clearly be affected by how one decides to treat eligible non-claimants. Hills (1982) has argued, using U.S. data, that if one considers individuals who reported zero UI income as having a replacement rate (defined as UI benefits/weekly wage) equal to zero, one gets the standard finding of a strongly significant effect of the replacement rate in increasing unemployment duration. However, if one drops such individuals from the regression (on the grounds that UI incentives are irrelevant to them from choice, since only a minority can be estimated to be disqualified from UI) then the effect of the replacement rate on unemployment duration becomes insignificantly different from zero.

Glenday and Alam (1982:73-84) adopted a different approach and simply estimated the probability of re-employment separately for claimant and non-claimant samples.** They estimated, as well, the determinants of the probability that an unemployed individual will claim for UI (and found significant regional differences as well as a lower rate of claim among job quitters). However, they did <u>not</u> correct their estimates of the determinants of

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**About 80% of the non-claimants had 52 or more insured weeks and a further 5% had over half a year of insured employment.
**Since the replacement rate was .66 throughout this period, the only aspects of the UI system which were examined were benefit week eligibility and dummy variables for above average earnings and the 1977 legislative changes.

unemployment duration (e.g., benefit week eligibility) to account for the presence of sample selection bias. As they noted "When no UI benefits are collected in an unemployment spell, workers find jobs fast on average" (1982:94) - perhaps because workers who have good reason to anticipate a short spell of unemployment often do not bother to claim UI.** One could only claim that omission of sample selection bias correction was unimportant if unemployment duration and the probability of claiming UI were uncorrelated. Hence it is just not satisfactory to estimate the determinants of unemployment duration separately for claimants and non-claimants. Individuals in fact decided whether to enter each population and their choice was affected by some of the same variables (local labour market conditions and UI regulations) which are thought to affect unemployment duration. Without considertion of sample selection bias, the coefficients in the separate regressions are necessarily suspect and no great reliance can be placed on them - or on the policy conclusions (a decrease in regional differentiation of UI) for which they form the basis.

Estimating behaviour using sample selectivity bias correction terms has forced economists to look (currently in a rather ad hoc way) at the predictors of the probability of labour force participation, college attendance, marriage, children, etc.

**E.g., individuals who quit one job and have another lined up and who would face a period of disentitlement even if they did file a UI claim.

This implies that richer data sets are continually being used by academic economists, but there is a continued consciousness of the unobservable variables which are correlated, in an unknown way, with those observed characteristics. It is therefore essential in a microsimulation model to ensure that the data base for such a model contains as much as possible of the underlying intercorrelation of observable variables as possible, since one will often want to distinguish between the factors which influence an individuals membership in a sample category and the factors which influence their behaviour, given that they are a member of that sample category.**

From the point of view of micro-simulation modelling, the current re-writing of the academic labour economics literature due to the ubiquity of sample selection bias makes it especially dangerous to impose now the assumption of zero cross correlation among sets of variables, as one would have to do if the data set were to become wedded irretreviably to 'stochastic imputation' as a methodology. In principle, one would argue for the exact matching of records in the data base underlying any microsimulation model -- as a practical matter one would argue for synthetic matching.

**E.g., for policy purposes one may need to distinguish between the factors which influence a persons decision to claim UI and the determinants of the length of a claim, once one has been established.

3.4 The Non-Linearity of the After Tax Budget Constraint

Figure 3.3 replaces the assumption of a constant after tax wage rate with the assumption that income is a non-linear function of hours worked. Two broad classes of models produce this effect -- those which incorporate variable marginal productivity of labour over the working day and those which incorporate progressive income taxes into the model. Both pose highly significant problems to a simple decomposition of labour supply responses into "income" and "substitution" effects.

If the net productivity of workers varies over the working day, perhaps because of set up costs to starting work in the morning, then the average output per hour would be greater for a full time worker than for a part-time worker - which is one "neoclassical" explanation for the lower hourly wages usually observed among parttime workers. Conversely, fatigue may imply that output in the last hour of work in a working day declines as the hours of work increase. Either way, the simple single equation estimation problem outlined in section 3.1 becomes a simultaneous equations problem where hours of work and the pretax wage are jointly determined. Baffoe-Bonnie (1985) finds strong support for the proposition that pretax wages in a sample of Maritime workers are a function of hours of work, and estimates a simultaneous equations model of labour supply.

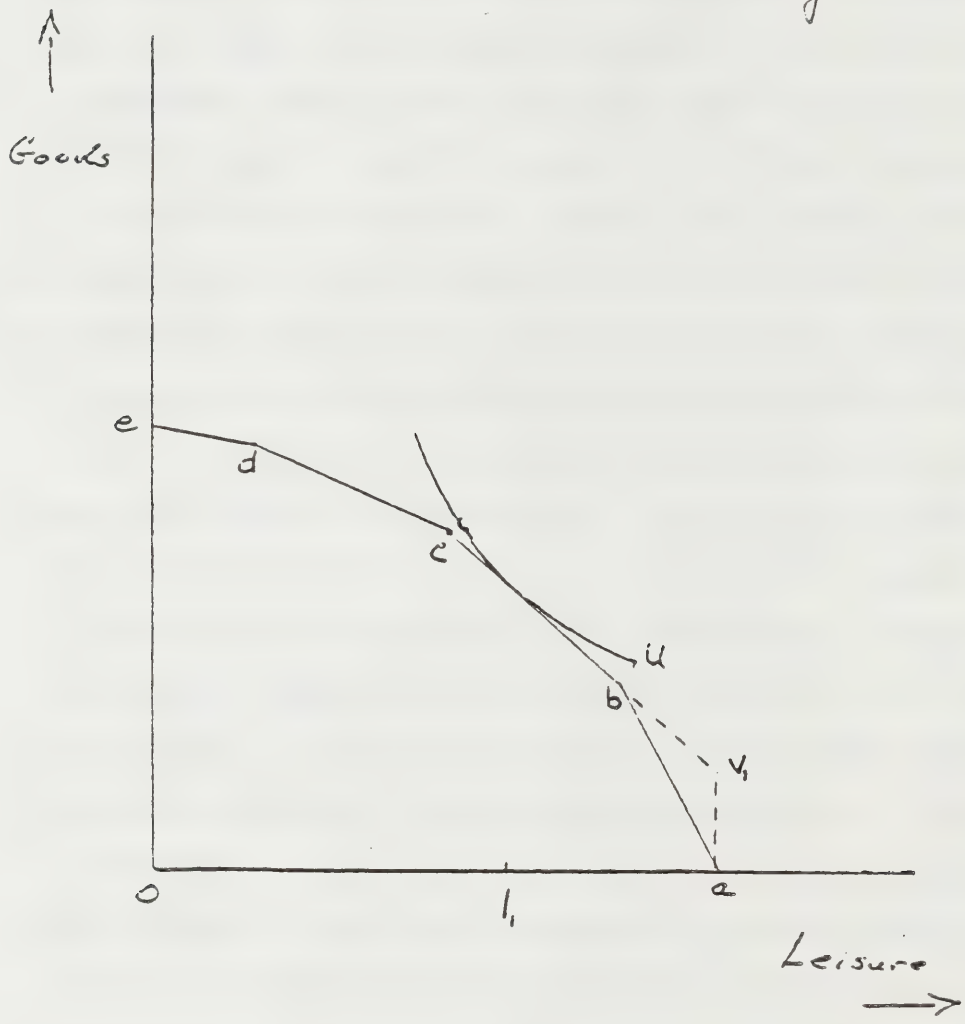
Additionally, we know that the rate of taxation on taxable income increases in steps as we move up the income range -- i.e., the tax function is piece wise linear with an increasing marginal

tax rate. This implies that in choosing hours of work a worker is also implicitly choosing an after-tax wage rate, since the more hours one works the higher is one's gross income and the higher the tax rate. Econometrically, the problem is that a single equation model of the supply of labour subject to a wage constraint, which has fairly clearly defined income and substitution effects for any particular change in the pretax wage rate, becomes a complicated simultaneous problem where the income and substitution effects associated with any given increase in pretax wage rates depends on the segment of the income tax schedule which is applicable, which depend in turn on the number of hours worked.

In general, the theoretical importance of a non-linear income tax is only now becoming fully recognized. Blomquist (1985) argues that few of the results valid for a linear income tax system in a multi-period model of utility maximization and labour supply carry over to the non-linear case, since the saving/dissaving decision now depends on hours of labour supply in each period, as well as on interest rates and time preferences. Pissarides (1983) points out that the disincentive effects of unemployment insurance are reduced to the extent that the income tax system is progressive. The higher the degree of progressivity in the income tax system, the lower will be the reservation wage of the unemployed, for any given level of unemployment insurance benefits. The basic reason is that the optimal reservation wage in a search model of unemployment

FIGURE 3.3

Labour / Leisure Choice with a Non-Linear Budget Constraint



depends on the gains from search, which depends on both the mean of the distribution of potential after-tax wage offers and its dispersion. Taxation which reduces the dispersion of after tax wage offers will imply lower reservation wages, since it implies a lower return to continued job search.

One research strategy advocated in several papers by J.A. Hausman (e.g., 1981) has proceeded by: (a) restricting the discussion to a one period time frame; (b) assuming that each segment of the piece wise linear progressive tax regime (e.g., the segment bc in figure 3.3) can be seen as approximately equivalent over that range to a proportional income tax regime with a constant marginal tax rate and the receipt of an additional gift of added income (this has come to be called "virtual income" and is represented in figure 3.2 by the line segment av_1); (c) assuming a particular specification of the utility function (defined over leisure and posttax income); (d) calculating the maximum level of utility associated with each of combination of proportional tax rates and virtual incomes; (e) selecting that combination of hours, tax rate and virtual income that maximizes individual utility.

Changes in tax rates, or in other government programs, are then modelled in terms of income and substitution effects <u>given</u> the presumption that an individual is on a particular segment on the budget constraint -- i.e., the income effect of a particular policy change is seen as creating an addition to or a subtraction from the "virtual income" associated with that segment of the tax

schedule and as producing a change in the marginal (proportional) tax rate.

However, Heckman's (1981) critique of this approach is particularly thorough. He notes that even if one allows for heterogenous preferences, by including a stochastic term in the utility function, the results are sensitive to the a priori specification of the structure of the utility function. Furthermore, the methodology requires that the budget set confronting the consumer be known to the econometrician, which ignores both the fine detail which actually occurs in individual tax liability and any possible tax avoidance. A model which restricts itself to considerations of utility maximization within only one period is totally out of step with the entire human capital research tradition, which argues that individuals attempt to maximize their utility over much longer periods of time. Finally, since the estimated substitution effect is only obtained via the Slutsky equation methodology of subtracting a presumed "income effect" from an uncompensated wage effect, the size of the presumed income effect is crucial.

Moreover, in Hausman's work the estimated size of the income effect depends crucially on the imputation for "virtual income" which is arrived at in the approximation to the tax schedule. The 'income effect' is constrained, a priori, to be positive (despite occasional findings that it is negative (see Killingsworth (1983: 193-198)). These assumptions are of considerable policy relevance, since Hausman's rather large

estimates of the deadweight loss which is implicit in a progressive income tax system compared to a "flat rate" proportional tax system depend crucially on the size of the compensated wage elasticity of labour supply - but this is basically equal to the negative of the income effect, since the uncompensated wage elasticity of labour supply for males is essentially zero in his work.

Fortin, Rousseau and Fortin (1984) in their evalution of the Quebec White paper on Tax and Transfer Reform follow the Hausman approach.** But one way of reading their work is to see it as a concrete example of how imoprtant it is to get a correct estimate of the compensated wage elasticity of labour supply. Their estimate that the deadweight efficiency loss involved in the Quebec tax/transfer system is 37% of Quebec's net domestic product is rather dramatic but it becomes an estimate of 15% when they switch from a "high" estimate of labour supply elasticities (i.e., Hausman's) to an "average" labour supply elasticities estimate.**

However, either set of labour supply elasticities is

**With the 'general equilibrium' addition that the demand for labour by skill-category is a derived demand, whose elasticity is assumed to differ by skill category, within the maintained hypothesis that in aggregate the elasticity of substitution between capital and labour is one -- i.e., a Cobb-Douglas production technology with constant aggregate factor shares.
**This 'average' is evidently <u>not</u> taken directly from Killingsworth (1983: 193) despite Fortin's footnote on Page A-9 since the average of the non-Hausman estimates for males presented by Killingsworth is 0.22 and the average for females is .98.

considerably greater than those reported by Nakamura and Nakamura (1981) and very much greater than those reported by Stelcner/Smith (1985). Hausman (1981) reports a compensated wage elasticity of approximately +1.0, while Fortin et al (1984: pg. A-9) state their "average" estimate of labour supply elasticities to be about half as large (i.e., about +0.5). The simple average of the Nakamura estimates of the compensated wage elasticity of female labour supply (Nakamura, 1981: 483), for 7 age groups of Canadian women is 0.097, while the average of the Stelcner/Smith estimates (1985:22) is lower still at 0.0247.** If one extrapolates the deadweight loss estimate as a linear function of labour supply elaticities, on the Nakamura or Stelcner/Smith numbers the deadweight loss of the Quebec Tax Transfer system is nil.

The methodology of the Fortin study is (1) to identify a specific number of household "types", (e.g., two parent family, single parent family, childless etc.), (2) to estimate a behavioural response to social legislation for each type of household and then (3) to multiply the estimated response by the number of each type of household in the Quebec population and (4) to sum across all household types. This methodology implicitly imposes the constraint that households cannot change their "type"

**The standard result is that labour supply elasticity for women exceeds that of men, but the Nakamuras argue that working wives and working husbands exhibit similar behaviour, if one adequately controls for economic influences specific to women (e.g., the presence of pre-school children or restricted labour demand due to job discrimination.)

as a response, however indirect, to social legislation (e.g., tax policy cannot affect, via the divorce rate, the number of two parent and single parent families). By contrast, the micro-analytic simulation methodology (e.g. as developed by Orcutt (1976)) starts with a statistically representative sample of the population and then computes, for each household, its predicted behaviour as a function of household characteristics and economic incentives.** Households with particular characteristics (e.g., a two parent family in a given region with particular levels of education) are therefore predicted to face specific economic incentives (e.g., a given wage and tax schedule) and to behave in specific ways (e.g., increase hours of work or become unemployed). Behaviour such as marriage, divorce or having children is, however, also sensitive to economic incentives and to current and lagged values of household characteristics. Indeed, Orcutt (1976:116) found recent unemployment of the family head to be the most important single variable predicting probability of divorce. (Family income was also statistically significant.) For this reason, the DYNASIM model incorporates a series of modules which predict divorce, marriage, fertility and death. Legislation which affects family

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**The term "predicted" must be stressed, since each individual household is in fact assigned (in order to preserve the stochastic variability in micro-data) a value drawn from a distribution whose mean is the expected value, given household characteristics, of each type of household behaviour (e.g., labour supply) but whose variance is the standard error of the regression predicting that type of behaviour.

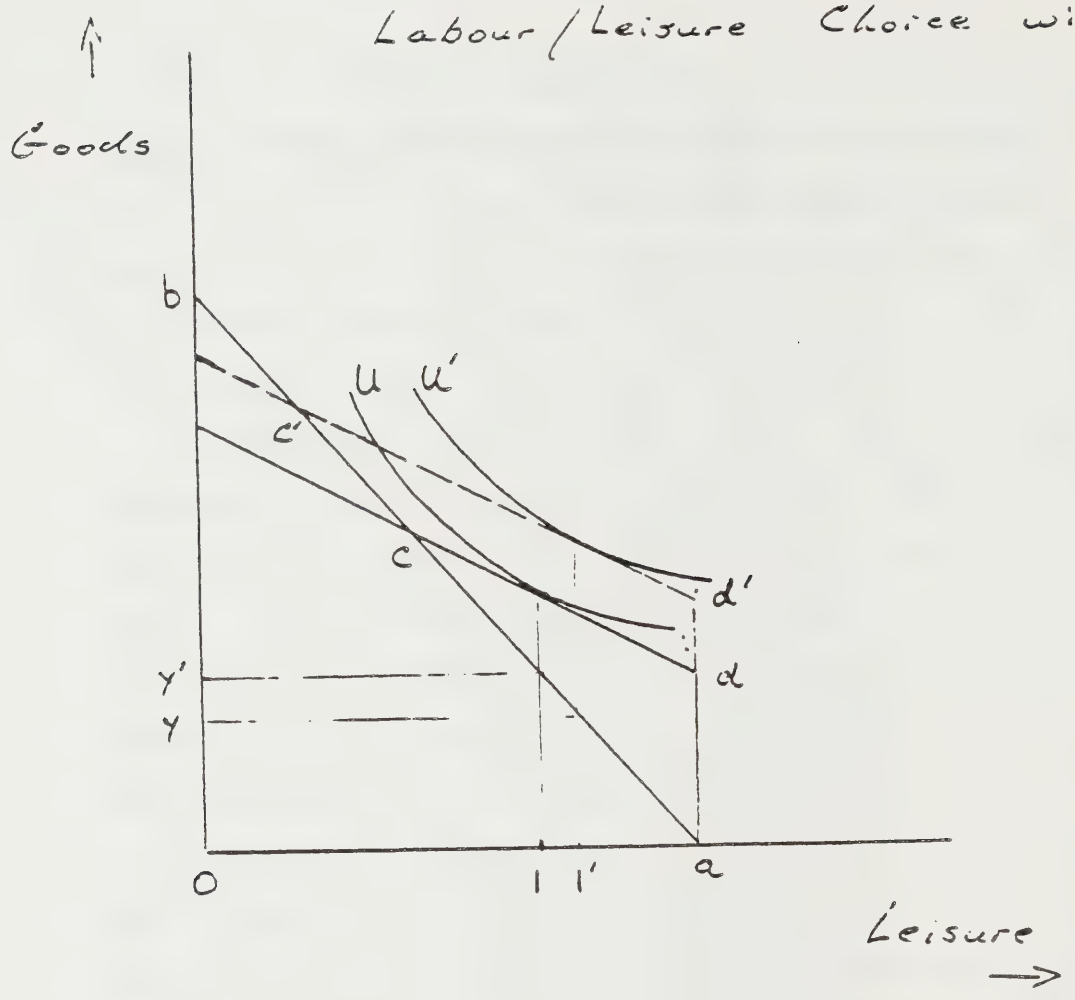
incomes and the employment probability of individuals will, over time, affect the relative proportion of family types. Micro-analytic simulation can incorporate such indirect effects and is thus inherently more able to deal with the full impacts of legislation than 'ideal type' methodology of Fortin et al.

In addition, one must file a strong note of protest at the assertion in Fortin et al (see 1982:XI, 39) that revision of the social welfare system will "generate jobs" according to their model. It is, perhaps, understandable that during an era of high unemployment researchers will want to claim for their work some relevance to this pressing social problem but one must remember that this study is a pure labour supply model which is based on the premise that no individual is constrained in their hours of work. Fortin et al use the estimates of wage elasticity of labour supply discussed above to derive a predicted increase in hours of work for each of 34 types of individual. The predicted increase in hours of work of each type of individual is multiplied by the number of such individuals and the answer is summed across all types of individuals to give an estimated total increase in hours of labour supply. This increase in total hours of work by already employed individuals is then divided by 1875 (since 50 weeks x 3.75 hours per week = 1875 hours) and the result is presented as the number of "full-time jobs" created by a programme revision. To say that this has anything to do with "job creation" is sloppy and misleading. The labour/leisure choice framework assumes flexible hours of work, hence assumes

away any constraints which individuals may face in locating "jobs". Analysis of involuntary unemployment requires a fundamentally different perspective.

FIGURE 3.4

Labour / Leisure Choice with UISP



3.5.1 Individual Labour Supply and Behavioural Response: The Example of UISP

One example of a type of program which fits easily into the labour/leisure choice framework is the "guaranteed annual income" concept, of which the recent proposal of the Royal Commission on the Economic Union and Development Prospects for a Universal Income Security Plan (UISP) is representative.** In such a program, individuals receive a guaranteed level of income and are taxed on their income, so that their total money income is equal to the guarantee level plus after tax earnings. In diagrammatic terms, the guarantee level can be represented by the line segment ad in figure 3.4 and the after tax wage rate can be represented as the slope of the line segment de (the pre-tax wage rate can be represented by the slope of the line segment ab).

The net benefits of a guaranteed annual income system to an individual are therefore equal to the difference between the guaranteed income they receive and the total taxes which they pay on their earnings. The "breakeven point" (c in figure 3.4) is the point at which the taxes paid on earnings are equal to the guaranteed income. The breakeven point will be higher, the higher is the guaranteed income and the lower is the tax rate (t) on individual earnings. At income levels above the "breakeven" point, an individual will pay net taxes to government and at

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**The cynical may indeed claim that the continued popularity of a guaranteed annual income concept among economists is due, in no small measure, to the ease with which economists can analyze such a programme using the most basic theoretical tools.

income levels below the breakeven point an individual receives a net subsidy through the guaranteed annual income system. Clearly, the fiscal burden of a system such as the UISP will depend upon the combination of the guaranteed income level chosen and the tax rate on earnings which is selected.

One of the problems of design involved in creating a guaranteed annual income program such as the UISP is the three cornered trade-off between total programme cost, the goal of insuring income adequacy to non-participants in the labour market (which would imply a high guarantee level) and the goal of enhancing work incentives for labour force participants (by choosing a low tax rate on earnings). Choosing a high guarantee level, in combination with a low tax rate on earnings, will guarantee a high breakeven point, and the higher the fraction of the population which receives net subsidies through a guaranteed annual income program, the greater is the fiscal burden of the program.

If, for example, a higher basic guarantee level such as ad' were proposed, even with the same tax rate (t) on income, the breakeven point would increase to c'. If leisure is a normal good, the labour/leisure choice framework would predict that individuals consume more leisure (i.e., the number of leisure hours would increase from l to l'). And the decrease in labour supply would produce a decrease in earned income (from y to y').

Even this simplest case, therefore, illustrates one of the advantages of a behavioural microsimulation model over the use of

impact analysis. In analyzing the impacts of UISP, an analyst who looked only at the impact of a UISP would implicitly assume that leisure hours remained unchanged after an increase in the guarantee level, which would imply that earned income and the tax revenue from earned income would also remain constant. The net cost of an increase in the guarantee level would therefore be simply the increase in payments to individuals (in the diagram the distance dd'). However, using a microsimulation methodology, one would predict earned income to decrease by the amount yy', and, therefore, tax revenue would decrease by an amount equal to t.yy'. The net cost of an increase in the guaranteed level would therefore be the increase in explicit payments (dd') plus any decrease in tax revenues (t.yy').**

Furthermore, as Wolfson (1985) and Kesselman (1986) have noted, instituting a UISP which is financed by substantial alterations to existing tax and transfer programmes** and the imposition of a 20% tax back rate will both (a) produce substantial changes in net income for individuals and families with specific characteristics at all income levels and (b) considerably increase marginal tax rates for many families rates. Both these impacts can be expected to affect the labour supply

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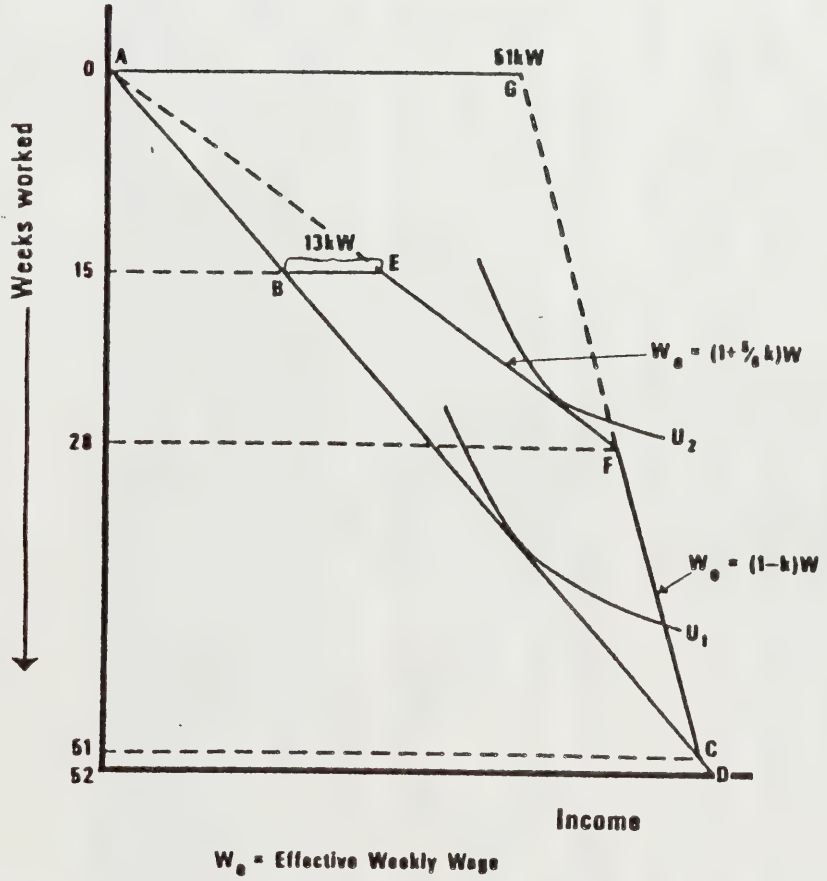
**We are, in this section, presuming that the labour/leisure choice framework is a useful way of analyzing the work responses of the "working poor". Section 4 discusses some of the difficulties with this presumption in more detail.

**Family allowance, the GIS, Child Tax Credit, child exemptions under income tax, social housing expenditures, federal spending on CAP and marital exemptions are all proposed for abolition to be replaced by UISP.

FIGURE 3.5



W_e = Effective Weekly Wage

FIGURE 1 Seasonal UI benefits – 1955 Act, one-year decision period

FIGURE 3.5

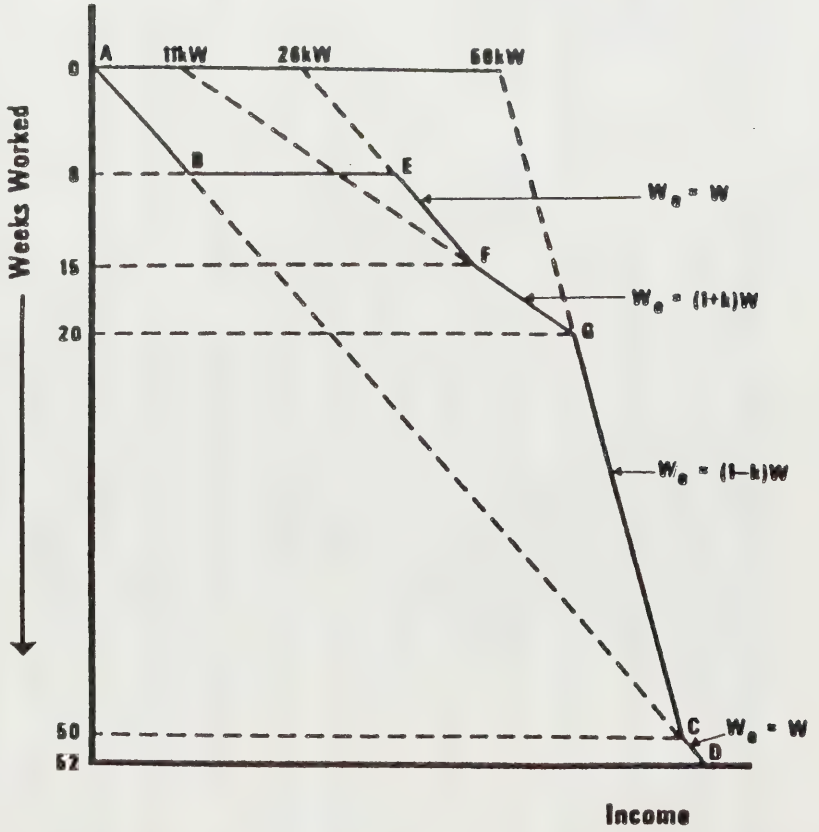


FIGURE 2 UI benefits – 1971 Act; one-year decision period, over 5 per cent unemployment rate, no dependents

decisions of individuals. Wolfson (Table 3), for example, notes that the impact of the MacDonald Commission proposals on families in the 40 to 50th percentile of the income distribution will be an average net gain of $1000, but the top 10% of that income group will gain $3775 while the bottom 10% will lose $175. The "Income effect" on labour supply of the proposals will therefore differ widely even within income classes. In addition, some families will face new, higher effective marginal tax rates even while the disincentives facing current welfare recipients decrease. The net effect on labour supply of all these changes cannot be predicted from theory alone - indeed only a behavioural micro-simulation model can really keep track of the impacts of a programme such as the UISP.

3.5.2 Individual Labour Supply and Behaviour Response: An Example from Unemployment Insurance

The labour/leisure choice framework has also been used to analyze the impact of unemployment insurance on the labour market. Figures 3.5 and 3.6 are drawn from the work of Rea (1977)** who used such a framework to analyze the 1971 revisions to Canada's Unemployment Insurance Act. The diagrams represent the budget constraint facing the "typical" worker if one is willing to assume: (a) that all unemployment is equivalent to

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**Green-Cousineau (1976) followed a similar, but less sophisticated, approach. Glenday/Alam (1982) and Phipps (forthcoming) also present models of this type.

leisure; (b) that there is no policing of unemployment insurance system, so that receipt of unemployment insurance is purely a decision for the individual; (c) that hours of week per work are fixed, so no worker can substitute hours between weeks within the year; (d) that the decision period for an individual is one year in length; (e) that no individual chooses more than one period of unemployment per year and (f) that the wage rate received by the individual is unaffected by experiences of unemployment, both now and in the future. If one is willing to accept all this, then one can analyze the impacts of unemployment insurance in terms of its impact on labour/leisure trade-offs, via the change it implies in the effective price of leisure. Eligibility for unemployment insurance is said to mean that the net wage for continued labour supply falls to (1 minus the replacement rate on unemployment insurance) x the gross weekly wage.

To simplify somewhat, the microsimulation methodology involved in using a labour/leisure trade-off framework to analyze a complicated program such as unemployment insurance requires one to locate each individual prior to a reform in the system on a budget line such as that represented by Figure 3.5. One then computes the income and substitution effects involved in a change in budget regime (e.g., to a system such as that of figure 3.6), using some estimate of the compensated wage elasticity of labour supply and income elasicity of labour supply. One need not, of course, restrict the analysis to unemployment insurance regimes which are actually implemented, since it is equally easy

to draw budget constraints for hypothetical unemployment insurance regimes. In this sense, the flexibility of the income/substitution effects framework is a major advantage.

However, it is also often necessary to be more than a bit "ad hoc" in imposing constraints on the operation of this sort of microsimulation model if it is not to generate unreasonable aggregate predictions. Within the labour/leisure choice framework upon which the model is based the only people who do not claim unemployment insurance within any given year are those whose tastes for leisure are such that they prefer to work almost all the year (and hence are at a "near corner" solution, line segment CD in figure 3.5. However, as Rea notes (1977:277) only a minority of the Canadian labour force are unemployed at any point during any given year.** If any of these are involuntarily unemployed, then the relevance of the labour/leisure choice analysis of unemployment insurance impacts must be restricted to something less. The choice of what fraction of the population is believed to respond in the way predicted by income/leisure analysis of labour supply is at least as important as the choice of elasticities of labour supply which are used.

Analyzing the impacts of the UI system using the labour/leisure choice framework is thus much more problematic

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**During the 1970s about 20% of those who were in the labour force at some point during a year were also unemployed during the space of a year, but in the 980s the rate is 26% to 28% - see Annual Work Patterns Survey S.C. 71-531 and 71-001; 7/85. As noted in Section 3.3, in over half of all unemployment spells individuals do <u>not</u> file for UI benefits.

than analysis of the UISP. The outstanding defect of using this methodology to analyze unemployment is that there is a great deal of evidence that unemployment is not equivalent to leisure for most unemployed workers (see Osberg, 1986c). Furthermore, UI is a far more complicated system than a guaranteed annual income programme, and to the extent that a characterization of the programme such as that represented in Figure 3.5 is in error, the predictions based on it will be misleading. For these reasons, a labour/leisure choice framework can only be defended as an 'easy first step' in analyzing the behavioural response of individuals to UI.**

The strengths of the labour/leisure model lies in the capability it creates to model many alternative policy proposals by representing them in terms of the budget constraint facing consumers. This flexibility is a major advantage** but it is not costless, since alternative policy initiatives which have the same impact on the budget constraint are presumed, a priori, to have the same impact on behaviour, and this presumption may be problematic. For example, two possible policy changes which might produce the same "income effect" for UI claimants are an increase in the waiting period for UI benefits and a decrease in family allowance benefits.

By assumption, the labour/leisure choice framework sees UI

**See Phipps (forthcoming) for a comparison of labour/leisure choice models of UI compared to constrained choice models.
**See Section 5 for further discussion.

regulations as simply altering the budget constraint which individuals face. Therefore if one were to lengthen the waiting period for UI benefits by n weeks, individuals who claimed UI benefits (i.e., were on segment EFGC of figure 3.6) would lose income equal to nkW (where k is the replacement rate and W is the weekly wage). In terms of diagram 3.6 the line segment EFGC would simply shift to the left.** Lengthening the waiting period for UI benefits would involve a pure "income effect", and the impact on labour supply would therefore be calculated as nKW/Y (the percentage change in income) multiplied by the income elasticity of labour supply (see Section 3.6).

However, one could also achieve a comparable "income effect" for UI claimants by other changes in the tax-transfer system, for example by changing family allowance payments. If one believes strongly in the labour/leisure choice framework, one will argue that individuals will behave similarily in response to any combination of policy initiatives which have the same net impacts on unearned income and net hourly wages. The more skeptical may well stress other behavioural responses and may believe that the method of programme delivery can, in itself, have significant impacts.

For example, our earlier discussion of the UI system and the sample selectivity bias issue noted that over half of all spells without employment between 1974 and 1979 did not produce a

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**Line segment BE would shorten by nkW and line segment CD would be proportionately longer.

claim for UI. Although the cost (in time and travel expenses) of filing a UI claim is surely very small, individuals who knew they faced a long waiting period for benefits (e.g., because they had quit their previous job) may not have thought it worthwhile to file a claim, especially if they had a reasonable expectation of finding a job in the near future. Indeed, the most clearly statistically significant, and empirically largest, variable in predicting the probability of a UI claim is whether the individual quit his/her previous job (Glenday/Alam 1982:84). One might, on this basis, argue that an increase in the waiting period for UI benefits would reduce the fraction of the unemployed who file for UI,** as well as altering the labour supply of UI claimants (via an income effect). The implications for the probability of filing a claim of altering the waiting period would undoubtedly be partially dependent as well on such variables as the local unemployment rate, hence one ought to attempt to model both the impact of longer waiting periods on the percentage of the unemployed who file for claims and the unemployment duration of claimants. The general moral is, therefore, the necessity of going beyond the labour/leisure choice framework if a fuller understanding of behavioural response is desired.

**A point estimate of the waiting period effect on UI claims can be obtained from Glenday/Alam (1982:84) but a more reliable estimate would require a specific study spanning the changes in waiting periods instituted during the 1970's.

3.6 The Non Concensus on Labour Supply Behaviour

The vast majority of articles about labour supply in the academic economics literature have been written from a theoretical perspective such as described in 3.1 above, or an extension thereof. Although there is a broad concensus among many labour economists on the appropriate theoretical perspective within which to analyze labour supply issues, it is noteworthy that there is much less concensus as to the empirical magnitude of labour supply responses to changes in the wages or non-wage income received by individuals. Table 3-1 reports a variety of labour supply estimates for males, and Table 3-2 presents some recent Canadian studies concerning the labour force behaviour of females. Since the labour force participation rate of men has, especially for prime age males, always been relatively high, the sample selectivity bias issue in labour supply equations has been of greatest importance in the labour force behaviour of women. The estimates in Table 3-1 and Table 3-2 have been selected from the larger literature on labour supply, [much of which is admirably summarized in Killingsworth (1983: pp. 182-199, 202, 111-125)] on the basis that the estimates have an a priori case for relevance to a Canadian micro-simulation model. Empirical results based on partial samples (e.g. blacks, welfare recipients) have therefore been excluded.** Canadian results are

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**Different results for blacks than for whites, can be explained as due to tastes, discrimination or adaptation to discrimination - all of which imply that results for blacks do not predict aggregate population responses. As Section 4.1 indicates there

emphasized, where available, and estimates which do not incorporate tests for sample selectivity bias have been excluded.

In general, the lack of concensus in the U.S. literature in the literature is quite outstanding. The uncompensated wage elasticity of labour supply for males, as reported in Killingsworth (1983: 119-123, 193), is small and negative in most studies (implying a backward bending supply curve of labour). The total income elasticity of labour supply is estimated to be generally negative, and usually "small" - i.e., usually not below minus 1. Most remarkable however, is the fact that although the only unambiguous prediction from neoclassical labour supply theory is that the compensated wage elasticity of labour supply must always be equal to or greater than zero, some thirteen out of the thirty-five estimates in Killingsworth (1983: 119-123) report a negative compensated wage elasticity of labour supply.

There is, if anything, even less concensus on the labour supply behaviour of females. As Killingsworth (1983:205) notes, second generation work provides estimates of the uncompensated wage elasicity of female labour supply of "anywhere between -.89 and plus 15.24", which is quite a wide range.

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is good reason to think that estimates of labour supply responses of the poverty population may present some very difficult problems of interpretation.

TABLE 3.1

SELECTED EMPIRICAL ESTIMATES OF LABOUR

SUPPLY ELASTICITIES - MALES

Study	Wage Elasticity		Total Income Elasticity
	Uncompensated	Compensated	$(\frac{\partial H}{\partial Y} \cdot W)$
Ham (1982: 346) (a)	-.14	-.06	-.08
Macurdy (1983: 285) (b) log	.69	1.43	-.74
linear	.27	.71	-.44
Blomquist (1983: 186) (c)	.08	.12	-.04
Blundell/Walker (1982) (e)	-.23	.13	-.36
Hausman (1981) (f)	0.00	.95	-.95
Baffoe-Bonnie (1985: 144) (v)	-.17	.03	-.20

Notes to Table 3.1

(a) Ham (1982)

- explicit treatment of sample selectivity issue arising in labour supply estimates when some workers are underemployed or lose working time due to strikes (the two cannot be separated in Ham's work).
- negative compensated wage elasticity of labour supply is statistically significant.
- no discussion of taxation issues.
- age effect assumed independent of wage.
- all males 25 to 50 1967 to 1974 P.S.I.D.

(b) MacCurdy (1983)

- pseudo-dynamic model using Denver Income Maintenance experiment (expectations re future income assumed to be captured via current period savings behaviour).
-small sample caveat

(c) Blomquist (1983)

- Hausman type methodology for Sweden, random sample of 5616 plus tax data - ML estimates
- wage rate estimate upward biased (1974 wage used to explain 1973 hours)
- non-labour income and tax treatment of housing create measurement error in virtual income measure.

(d) Hausman (1981)

- all the mileage is in the 'virtual income' term implying that

the modelling of the tax system is crucial - note Heckman's (1983) comments

- limitations of 1 period model especially crucial when "virtual income" is being treated as equivalent to "income effect"
- a priori specification of utility function
- income effect constrained to be negative

(e) Baffoe-Bonnie (1985)

- whole sample log specification results given here - evidence of segmentation found in Maritime panel of 520 workers
- pre-tax hourly wage rate set in simultaneous equation 3SLS model with endogenous wage, (labour supply set with respect to post-tax wage, with linearized approximation to income tax system).

TABLE 3.2

SELECTED EMPIRICAL ESTIMATES OF LABOUR

SUPPLY ELASTICITIES - FEMALES

Study		Wage Elasticity: Uncompensated	Wage Elasticity: Compensated	Total Income Elasticity
Canadian Studies				
Nakamura[2] (1981:483) (a)				
age:	25-29	-.370	-.15	-.22
	30-34	-.270	.215	-.495
	35-39	-.305	-.117	-.188
	40-44	-.086	.183	-.269
	45-49	-.085	.100	-.207
	50-54	.143	.414	-.271
	55-59	-.051	.025	-.076
Smith/Stelcner (1985:19) (b)				
annual weeks	20-34	.16	*	*
	35-54	*	*	*
annual hours	20-34	.21	+.41	-.20
	35-54	*	*	-.13
Robinson/Tomes (1985:161) (c)				
hourly wage (OLS)		-.22	*	*
hourly paid (OLS)		-.18	[-.18] (d)	0.0 (d)

* - not statistically significant at 5%.

Study	Wage Elasticity Uncompensated	Compensated	Total Income Elasticity
Stelcner/Smith (1985:22) (d)			
married women			
age 20-34 annual weeks	.0133	.0094	.0039
35-54	.0304	.0236	.0068
age 20-34 annual hours	.0191	.0456	-.0265
35-54	.0202	.0202	0.0
Mazany (1985) (e)			
married - all women	1.517	1.772	-.2546
workers	1.309	1.518	-.2097
Nakamura[2] (1983) (f)			
Children 6 h < 1400	-.108		
h ≥ 1400	-.048		
Children <6 h < 1400	-.128		
and 6-14 h ≥ 1400	-.040		
Children 6-14 h < 1400	-.197		
h ≥ 1400	-.036		
No Children 4-5 h < 1400	-.179		
h ≥ 1400	-.054		
None ever born h < 1400	-.087		
h ≥ 1400	-.037		
Stelcner/Breslaw (1985:1067) (g)			
Heckman	.399	0.487	-.087
GLS sim-equ.	1.284	1.521	-.238

[Income Elasticity not reported]

Notes to Table 3.2

(a) Nakamura & Nakamura (1981)

- U.S. and Canadian micro-data from 1970 and 1971 Cenuses; iterative calculation to account for mutual dependence of hours and marginal tax rates (same iteration methose used in Nakamura's 1983 article and Smith/Stelcner (1985) - essentially a gradient method. Basic equation is (1)

(1) $h^* = F(X, w(H_i^*))$

h^* = desired hours

X = control variables, including SS bias

$W(H_i^*)$ = net after tax wage rate (a function of hours worked). *(1) is estimated, with h_i^* initialized at 1, then predicted value of H^* is inserted in $w(h_i^*)$ and (1) is re-estimated and so on until estimates of F converge -- <u>if</u> tax function has <u>continually</u> increasing marginal rates the convergence is unique.) - local labour demand for female workers proxy; pre-tax wage not a function of hours, GLS wage estimates corrected for sample selectivity bias due to labour force participation. - sample split by age for married females, assuming husbands hours fixed.

(b) Smith/Stelcner (1985)

- Microdata from 1981 Canadian census. Hours and weeks equations estimated for all women and separately for 20 to 34 and 35 to 54, correcting for sample selectivity bias. Unlike Nakamuras, no proxies for local job opportunities or local

unemployment rate. Correction for income taxes a bit unclear as written -- an iterative calculation but although page 3 criticizes the Nakamura's for their treatment of virtual income, the definition of unearned income on page 7 is the same as the Nakamura's on p. 462. Husbands labour supply taken as exogenous. - elasticities for separate age groups reported here, significant differences between age cohorts.

(c) Robinson/Tomes (1985)

- uses York University Quality of life survey with specific responses on wages, hours for married women in "hourly wage sample" (195) and "hourly paid sample" (324); no correction for tax treatment; hypothesis of no sample selectivity bias not rejected; instrumental variables estimates twice as large as OLS for "hourly paid", four times as large as OLS for "hourly wage".

(d) - income elasticity not separately estimated but spouses income has (statistically significant) coefficient approximately equal to zero (.00001) and if a recursive household labour supply model were specified (as in Nakamura) this would equal the income elasticity, thereby implying the compensated wage elasticity.

(e) Stelcner/Smith (1985)

- 1981 Canadian census, specifies CES utility function where coefficients of probit model of labour force participation (assuming no fixed costs to employment) identify the utility function. A 'virtual income'/proportional tax linearization of the income tax system plus utility maximization for each woman

was used to simulate labour supply impacts of 1% changes in wages and virtual income.

- noteworthy for extremely low wage and income elasticity estimates (wage equation corrected for SS bias).

(f) Mazany (1985)

- uses 1975 to 1977 waves of P.S.I.D.; sets up a joint labour force participation/fertility decision and estimates by maximum likelihood, correcting for SS bias

- the only study to examine impacts of wages/taxes on labour supply and fertility, but pre-tax wage used, and no correction for progressive income taxation.

(g) Nakamura & Nakamura (1983)

- essentially the same methodology and data set as in Nakamura[2] (1981); aim is to test stability of structure of labour supply parameters for women working more or les than 1400 hours annually, correcting for sample selection bias. U.S. wage income variables corrected for regional price variation (made little difference).

- parameter instability found for part-time (< 1400 hours) versus full-time (> 1400 hours) married women by number of children. BUT uncompensated wage elasticity of labour supply still negative (income elasticity not reported)

(h) Stelcner/Breslaw (1985)

- Uses 2439 married women from Quebec and 1979 SCF

- major problem is lack of an "hours worked" variable,

hence wage variable is defined as annual wages/salaries divided by weeks worked

- sample selectivity bias correction for L.F. participation but not for part-time/full-time status [see Nakamura's (1983)] - negative S.S. bias finding is not credible

- dependent variable is weeks worked, control for unemployed male (dummy if < 26 weeks) is very rough.

- Nakamura-type treatment of income taxation

- estimates non-robust with respect to estimation technique (own wage elasticity = .4 if Heckman technique used, but = 1.28 if GLS used).

TABLE 3.3

SUGGESTED WORKING ASSUMPTIONS

	Single Females & Males	Married Females
Uncompensated Own Wage Elasticity	-0.1	-0.2
Compensated Own Wage Elasticity	0.1	0.1
Total Income Elasticity	-0.2	-0.3
Compensated Elasticity with respect to spouse's wage	0	-0.3

3.7 Choosing From Among Available Estimates

In Table 3.3 we present a list of suggested working assumptions on the probable values of wage and income elasticities for married females and for single females and males. Since it has already been noted that the published literature contains a wide range of estimates on labour supply behaviour, one cannot expect that any single point choice from the set of available estimates will command universal support. Different considerations also apply to evaluations of labour supply elasticities for married women and for men.

Table 3.2 presented a number of estimates of the labour supply elasticity of married women which, with one exception, were all computed using Canadian data. The single exception (Mazany (1985)) was included since it is the only available study which explicitly examines the linked decision of married women as to fertility and/or labour force participation and supply of hours. Nevertheless, its use of American data and its neglect of the complexity of income tax issues limits its usefulness for public policy analysis. It is particularly desirable to use estimates of labour supply behaviour based on Canadian data since the tax treatment of the earnings of married women differs fundamentally between the United States (where joint filing of income tax is an option) and Canada, where married women's earnings are taxed on an individual basis.** In addition, as

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**Over the initial few thousand dollars until the wife's earnings exceed the married exemption in the income tax act, earnings of a

Nakamura and Nakamura (1981) point out, wages for women are lower in Canada, there are fewer opportunities for jobs than in the United States and female labour force participation rates are, on average, lower. Finally, if social norms as to the labour force participation of married women differ between countries it would appear desirable to use local studies, where available.

The estimates reported in Table 3.2 all embody some attempt to control for sample selectivity bias and to account for the non-linearity of the income tax system. In one case, Stelcner/Breslaw (1985) the study of labour supply behaviour is marred by the unavailability of accurate data on hours of labour supply, necessitating dubious estimates of the weekly wage and of total labour supply. However, leaving the Stelcner/Breslaw paper aside, it is perhaps comforting that there is not really a very large range in the recent empirical estimates of the wage and income elasticities of labour supply for married Canadian women.

The American literature on the labour supply of married women typically concludes that for individual American married women, the uncompensated wage elasticity of labour supply is

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married Canadian woman are effectively taxed at the marginal tax rate of the husband. For this reason, the after-tax budget constraint of Canadian married women is non-convex over the initial range of earned incomes. This interdependency of husband and wives tax schedules is, however, only likely to be important for couples where the wife works part-time. However, Glaister et al (1981:187) have stressed the importance of recognizing the exemption from tax of income below the exemption level in understanding the labour supply behaviour of married male U.K. workers -- i.e., the <u>actual</u> tax treatment of earnings over the initial range of earnings can have imoprtant impacts on <u>aggregate</u> estimates of labour supply effects.

positive, i.e., as wages rise, the hours of work of married American women increase. (See Killingsworth (1983: p. 200). By this criterion, the Nakamura's finding of a negative uncompensated wage elasticity of labour supply (similar to that normally found for males) is anomalous. However, Robinson/Tomes (1985) have replicated that result, albeit with a somewhat peculiar data set (women reporting that they were hourly paid) and without correction for the impact of progressive taxation. The Nakamuras work on labour supply has a number of important strengths, notably their iterative method for calculating desired hours as a function of the after tax wage rate in a progressive income tax system, the explicit inclusion of demand side variables measuring local unemployment and opportunities for jobs, correction for sample selectivity bias in the labour force participation, rather extensive disaggregation of the married female labour force into age categories (1981) and by hours of work and age of children (1983) and explicit comparison with American data for similarly specified equations (1981).** In my opinion, they therefore represent fairly strong findings, and on that basis I would suggest an initial working assumption for a microsimulation of the behavioural response to tax legislation in

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**Killingsworth (1983:200) criticizes the Nakamuras for their omission of educational attainment variable in the hours equation (even after controlling for the offered wage) and for the lack of a work experience variable in the\ wage equation (the Nakamuras' split the sample by narrow age groups and use number of children and age at first marriage as proxies). However, the theoretical reason why these issues should be important is not clear.

Canada should use the estimates in Table 3.3, if no disaggregation by age is desired.**

Furthermore, although Smith/Stelcner (1985) and Stelcner/Smith (1985) come to qualitatively different conclusions as to the sign of the uncompensated wage elasticity of married female labour supply, it is worth noting that their estimates are rather small in terms of absolute magnitude (i.e., between +.01 and +.16. The Stelcner/Smith (1985) finding that the uncompensated wage elasticity of labour supply differed by age group, but within age groups was in the region of .01 to .03 is derived from a simulation methodology based on an estimated CES utility function. It is therefore rather difficult to know what the standard error of estimate is which surrounds such an elasticity estimate, and the degree of confidence with which one can say that this estimate is different from zero. The Smith/Stelcner (1985) paper uses 1981 Canadian census data and is basically similar in methodology to the Nakamuras paper of 1981 (which used data from the 1971 Census) -- with the significant omission of any variable controlling for local unemployment or opportunities for jobs in either the estimated wage equation or the hours of work equation. Since my own bias is to think that the demand side of labour markets is rather important, it follows that I think that the omission of this variable is also rather

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**The Nakamura estimates by age reported in Table 3.2 can be used if disaggregation by age is desired.

important.**

In the econometric literature on the supply of labour hours by males, Ham (1982) is the only study which attempts to deal directly with constraints on individual hours of labour supply such as strikes or short time working. His correction for the sample selectivity bias evolved in estimating male supply of labour hours over a sample which includes both constrained and unconstrained workers is a strong argument for his estimates of labour supply elasticities.** Ham's results are drawn from the Panel Study of Income Dynamics in the United States, but in the case of male labour supply there is both less reason, and less opportunity to rely solely on Canadian studies. Male labour force participation rates are much more constant across national economies than are female labour force participation rates. If one adopts the model of family labour supply behaviours suggested in section 3.2 above, namely that male labour supply is assumed not to be dependent upon the earnings of married women, then variation across nations in the tax treatment of secondary earners is not relevant -- by assumption, males are deciding on their hours of labour supply independent of the tax treatment of female labour earnings. Finally, one has the practical problem

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**The Nakamuras (1981 and 1983) report these variables to be highly statistically significant and with expected signs.
**Ham's finding that the compensated wage elasicity of labour supply is negative, not positive, and is statistically significant will be disquieting to the extent that the reader has a strong prior belief in the neoclassical theory of consumer choice. However, one can note that this finding is not unusual in the literature (see Killingsworth, 1983, pp. 118-121).

that very few studies have been done in recent years on the labour supply behaviour of Canadian males.

Given the range of estimates in table 3.1, or in Killingsworth (1983: 193-194) the essential problem in choosing estimates of the elasticity of labour supply of males is how much weight one wants to attach to "outlying" econometric observations. Among the "second generation" studies of male labour supply only the McCurdy (1983) article reports finding a positive wage elasticity of labour supply which is empirically large. (In the log specification equal to 0.69). Killingsworth (1983:193-194) reports some 23 estimates of the uncompensated wage elasticity of labour supply for males, of which 16 are negative, 2 are zero and 5 span the range plus 0.06 to plus 0.14. The simple arithmetic average of the uncompensated wage elasticity of labour supply reported by Killingsworth is -0.0575, which rounds to -0.1, as does Ham's (1982) estimate.

Brown's (1981:143) summary of the results both of his interview approach to analyzing the labour supply responses of U.K. manual workers and to the many econometric estimates using the same data set,** is also very similar "For men the elasticity is low and negative (perhaps -0.1)." Such an estimate would be consistent with our previous discussion of the wage elasticity of labour supply of females (which table 3.3 places at -0.2) since it is a common finding in the literature that the responsiveness

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**See Ruffell (1981), Ashworth and Ulph (1981), Glaister/McGlone/Ulph (1981) and Brown/Levin/Ulph (1976).

of female labour supply to changes in wages or income is greater in absolute magnitude than males. An estimate of -0.1 as the uncompensated own wage elasticity of labour supply for males is also consistent with much of the historic literature on male labour supply, which has tended to argue that the supply curve of labour for males is slightly backward bending.

In plain language, the concensus of the literature appears to be that for males a wage increase produces a small decrease in hours of work -- i.e., a 10% increase in the hourly wage will cause a 1% decrease in annual hours worked, or about half a week's less work for a full year worker.

In a one period model of labour supply, the value assigned to the income elasticity of labour supply is crucial. Macurdy's (1983) finding of a income elasticity of -0.74 is not directly comparable with the one period literature, since his is a model which explicitly argues for a dynamic, or life cycle, utility maximization framework. Macurdy's estimate is, again, an outlyer in the literature, as is Hausman's (1981) finding of an income elasticity of labour supply of -0.95. In the Macurdy model, current household savings play a crucial role in defining perceived lifetime income expectations. In Hausman's model the "virtual income" of a household is crucial. Both variables are undoubtedly measured with great error, providing some reason to doubt these outlying observations. The simple average of the estimates of income elasticity of male labour supply presented in Killingsworth (1983) is -0.3 (-0.317 if the Hausman estimate is

included, and -0.28 if it is excluded). By contrast, although Blomquist (1983) uses a conceptually identical treatment of the tax system to Hausman, his estimate of the income elasticity the income elasticity of labour supply for Sweden is far lower (at -0.04) then is Hausman's. Furthermore, Ham's (1982) study possesses the considerable advantage of correcting male labour supply elasticities for constraints on individual labour supply -- and his estimate of male labour supply is -0.08. Since the estimates of the income elasticity of male labour supply to which I give greatest credence are at the low end of the range of estimates of the income elasticity of male labour supply, my preferred estimate of the income elasticity of labour supply for males is -0.2, as reported in table 3.3. (This implies that a 10% increase in transfer income will be associated with a 2% decline in hours of work.) Given the estimate of uncompensated own wage elasticity of labour supply of -0.1 and the estimate of the total income elasticity of male labour supply -0.2, it follows directly that the compensated own wage elasticity of male labour supply is + .1.**

One can compare the working assumptions of Table 3.3 with those used in some current Canadian macro-models. The Small Annual Model (SAM) of the Bank of Canada uses a lifetime human wealth notion and attempts to compute medium to long term steady

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After writing the above section, I found a reference to very similar point estimates by M. Keeley (1981) -- i.e., an uncompensated wage elasticity of labour supply of -.11 and a compensated wage elasticity of .1.

state solutions. Since it pools males and females we must weight the estimates of Table 3.3 by their proportion of the labour force to compare estimated elasticities. For males and females taken together Table 3.3 implies on income elasticity of -.23, quite comparable to the Bank of Canada's estimate of -.28 (see Rose and Selody 1985:107). A difference arises in the estimate of the compensated own wage elasticity, which Table 3.3 puts at 0.1 and SAM puts at 0.34. (Since Table 3.3 refers to short-run behaviour, one would normally have expected a higher short-run elasticity.) Many criticisms can be made of the SAM model (e.g., arbitrary exclusion of data from 1979-81) and in general such macro estimates are unlikely to be superior to careful analysis of micro-data. The point, however, is that such macro models may well contains overstated estimates of labour supply responses and, as a result, the SAM model may overstate the changes in output due to proposed changes in tax regimes.

4. Problems with the Simple Framework

4.1 A Cautionary Tale

The idea that social policy can be analyzed within the framework of income and substitution effects in a one period model has been especially influential in the analysis of programmes aimed at the working poor. Analyses of the impact of negative income taxes or guaranteed annual incomes on labour supply have often been conducted in this framework (e.g., Gunderson, 1983: 117-154). One of the main rationales for a negative income tax/guaranteed annual income scheme has always been the decrease it entails in the disincentives to work which are implicit in current welfare schemes. If one adds together the value of subsidized daycare, rent geared to income housing, and welfare payments to low income households and then computes the decrease in total benefits which occur as earned income rises, it is normal to find that there are very high implicit marginal tax rates on earned income for the low income population (see, for example, Osberg, 1981: 198). In fact, due to the stacking of programme benefits (e.g., subsidized daycare plus rent geared to income housing plus welfare benefits) and the disqualification from the benefits of several programmes that may occur as earned income rises, it is not infrequent to find marginal tax rates in excess of 100% - i.e., net real income actually falls as earned income rises for some population sub-groups among the working poor.

Negative income tax/guaranteed annual income schemes are

explicitly designed to avoid these very high marginal tax rates on earned income and to decrease the disincentives to work effort which now exist. The substitution effect of a decrease in marginal tax rates (which is equivalent to an increase in the after-tax marginal hourly wage) is argued to increase labour supply but it is also recognized that the presence of a guarantee level may imply an income effect for programme participants. In addition, since the marginal tax rate on earned income for individuals who are not previously claimants under social welfare schemes may increase, the aggregate impact of a GAI on labour supply is indeterminant (but has often been predicted to be in the range of minus 2.5 to 4.3 percent (see Masters and Garfinkel (1977) or Keeley et al (1978)).

No guaranteed annual income scheme has yet been legislated in Canada or the United States,** but the discussion of work disincentives due to high implicit marginal tax rates in welfare programmes has had an impact on programme design. The Aid to Families with Dependent Children programme (AFDC) in the United States was amended in 1967 to allow recipients to keep the first $30 and one-third of any subsequent net monthly earning. This "earnings disregard" was instituted in order to keep the marginal tax rate on earned income implicit in the AFDC programme from exceeding .66. Keeping tax rates at this level was considered important because the recipients (women) were seen as being quite

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**The recent recommendation by the MacDonald Commission for a U.I.S.P. is, presumably, some way from the statute books.

responsive to economic incentives. Killingsworth (1983:205) has argued that "second-generation research indicates that structural responses (income and substitution effects) are considerably greater for women than for men, (which) confirms first generation findings". Since female family heads could in addition, be expected to have higher opportunity costs of time in household production than female non-family heads, one might expect that the implicit tax rate on net earned income would be a significant determinant of the hours of labour supply of AFDC programme participants.

However, in 1981 a sort of "perverse experiment" occurred which provided evidence on the actual responsiveness of work effort to tax disincentives. The Omnibus Budget Reconciliation Act (OBRA) instituted many important changes in the AFDC programme - chief among which was an elimination of the earnings disregard for employment of more than 4 months duration. A number of provisions of OBRA produced disqualification from AFDC benefits or reduction in entitlement to AFDC benefits for continuing claimants, but the outstanding characteristic of the OBRA amendments was the institution of a 100% marginal tax rate on earned income in continuing employment. For those who remained on AFDC after 1981, the OBRA amendments present an unambigous economic incentive - to decrease earned income to zero - <u>if</u> one analyzes labour supply using the income/substitution

effects framework in a one-period model.**

However, by now some 10 studies have been concluded on the actual impacts of the OBRA amendments on work effort.** Although all of these studies have their imperfections, they nevertheless reach the same two conclusions: (1) the OBRA amendments produced substantial declines in the total monthly income of AFDC recipients and those disqualified from AFDC; (2) the OBRA amendments had virtually no impact on hours of labour supply. A panel study based on two national probability samples of the AFDC case load (one drawn in September 1980 and the other in September 1981), found that OBRA had no effect on either the probability that a working AFDC recipient would move to being a non-working recipient or the probability that a non-working recipient would become a working recipient. Another study which focused solely on working recipients of AFDC benefits, again found that working recipients continued to work after the passage of OBRA increased their marginal tax rate on earned incomes to 100%. The General Accounting Office examined AFDC case loads at five specific cities, and the New York City Human Resources Administration collected data for about a year on three specific samples from

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**Moffitt (1985a) has argued that those AFDC claimants who move off the programme may increase labour supply, so the theoretical impact of the OBRA amendments on aggregate labour supply is ambiguous. However, the prediction is unambiguous for programme participants. Furthermore, one must beware of the perfect vision of hindsight, since almost all policy analysts at the time emphasized the work disincentives involved in a 100% marginal tax rate on long term earned income (e.g., Aaron, 1982: 150).

**This section depends heavily on Moffitt (1985a) and Focus (1985).

the AFDC case load. Again, the finding was that recipients who were employed prior to the cutbacks did not quit work as a result of OBRA. Since it is possible that the OBRA amendments may have discouraed individuals from going onto AFDC, Moffitt (1985a) argued that one should look at the labour force participation rate of female heads of households in aggregate, controlling for the impact of the general increase in unemployment during the 1981/82 recession. His cross-sectional study found no significant impact of OBRA on female labour force participation. In short, "panel or cross-sectional the astonishing thing about the studies that have been done so far is that they show remarkable unanimity in their results. OBRA seems to have had little or no effect on the work effect of single women who head households. Those terminated from AFDC because of the changes in the rules are no more likely (even in a recession) to be jobless and back on AFDC at a later date than were women who left AFDC before OBRA was implemented. (Focus, 1985: 8)"

Although further academic work may modify this conclusion in some way,**the evidence to date appears fairly clear - one must be extremely cautious in using a one period income/substitution effects model to analyze the labour supply behaviour of the

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**Moffitt (1985b) extends the data series used for his 1985a paper to include 1983 and 1984 and argues that disincentive effects may have become important by 1983, i.e., with a lag. However, the case is relatively weak since the relevant regression coefficient is only significant at the 10 percent level of statistical confidence in one equation, and is statistically insignificant in the other.

working poor. Remaining employed, despite a 100% marginal tax rate on current earned income, can be explained either by a desire to invest in on the job training/seniority and hence obtain future income, or by a desire to avoid social stigmatization - but neither of these considerations is part of the income/leisure one period utility maximization model which we have discussed in section 3.1.

From the point of view of a behavioural micro-simulation model, the major moral of this cautionary tale seems to be that one can only defend a one period labour/leisure choice model as a first, rough approximation to the impacts of a guaranteed annual income scheme such as the UISP. A more realistic analysis of the impacts of the UISP must take account of more of the variety of behavioural responses which will be entailed by programmes such as welfare reform or a guaranteed annual income. The "Mark 2" version of a behavioural micro-simulation model must begin to meet some of the criticisms which have been made of the simple labour/leisure choice model.

4.2. Criticisms of the One Period Model

One perspective on labour markets (which some might call "neo-classical") is that labour market outcomes can be explained as the result of well-informed individual utility maximizing choices in a unified, competitive, flexprice market for labour, where all individuals face an infinitely elastic demand curve for labour at a wage that is equal to their individual marginal

productivity. In addition, it is often assumed that all hours spent outside the paid labour market, either in unemployment, job search or home production, are essentially equivalent - - i.e., "leisure". Even within this perspective, the model of Section 3.1 has been severely criticized.

To begin with, the model outlined in section 3.1 is incompatible with the "human capital" research programme, which argues that individuals attempt to maximize their utility over their lifetime. At any point in time, the gross wage available to an individual is determined by their stock of human capital and the rate of return they obtain on it, as in equation 1.

1. $W_i = r_i K_i + W_0$

where r_i = the rate of return on human capital on the ith individual

K_i = the stock of human capital acquired by individual i

W_0 = the wage of "basic" unskilled labour.

In the "human capital" research tradition, a utility maximizing individual will accumulate, then decumulate, a stock of human capital in order to maximize lifetime utility. One of the chief methods of acquiring stocks of human capital is investment in on-the-job training, which is usually modelled in terms of an individual who forgoes part of their potential wage (k_i) in order to acquire additional skills, i.e., stocks of human capital as in equation 2.

2. $w_i = (1-k_i) W_i$

The money wage which we observe in labour market data is w_i. The wage which is relevant to the labour/leisure choice decision is W_i.** Since, in a cross-section of individuals one is sure to observe individuals who are at different stages in their human capital accumulation and decumulation program, use of the money wage (w_i) in place of the total returns to labour (W_i) will inevitably introduce a non-constant error into the measured wage.

The problem is accentuated if one aim of the model is to analyze the impact of taxation, or of changes in the level of taxation. A proportional tax system does not distort the relative interperiod value of market earnings, and hence poses substantially fewer analytical problems than the progressive income tax system, which we, in fact, have. Indeed, it can be argued that with the growth of RRSP's as a potential savings medium, the Canadian tax system has moved substantially in the direction of a progressive consumption tax.**

**J.P. Smith (1978) presents an example of a life cycle labour supply model. Such models typically presume that lifetime utility is a separable function of period utilities, with a constant rate of inter period substitutability of annual utility. They thus evade, by construction, any potential problems of dynamic inconsistency of savings/investment profiles discussed by Strotz (1956). However, one does not need to assume that the lifetime utility maximization decisions of an individual are intertemporarily consistent in order to query the foundations of a one period model - - any lifetime human capital acquisition plan will imply an inequality between the observed money wage and the total returns from labour.

**Since there is a ceiling on RRSP contributions the change to a consumption tax is incomplete. Ippolito (1985) notes that the choice of progressive, rather than a proportional income tax

As has already been noted in section 3.4, progressive tax systems massively complicate the analytics involved in predicting labour supply behaviour. For example, since the fraction of time spent in acquisition of on-the-job training (k_i) is a choice variable in the human capital model, it is quite conceivable for an individual to react to an increase in tax rates not by decreasing hours of work but by increasing acquisition of on-the-job training (since the fraction of the total wage invested in human capital (k_iW_i) entirely escapes taxation). If an individual had planned to reduce labour supply in future periods he/she might defer consumption to future periods, when earnings might be taxed more lightly. Current period labour supply as a function of current period aftertax money wages is therefore difficult to predict, since consumption of both goods and leisure can be substituted across periods.

In section 3.5, a model of the unemployment insurance system was presented, based on the one period labour/leisure model. In this sort of model, the "one period" assumption is particularly strong since it is assumed that unemployment in the current period has no implications whatever for future wages. Yet if

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creates an incentive for individuals to spread their working hours more evenly over their lifetime and take less leisure in the form of retirement, especially at high wage rates. But non-taxable savings forms (e.g., pension plan contributions, RRSPs) offset somewhat the distortions on leisure alternatives imposed by progressivity. The complex nature of the financial incentives facing individuals, and their possible responses, is, of course, one of the main reasons for using micro-simulation as a tool for policy analysis, rather than relying on introspection or simplified theoretical models.

market work has any on-the-job training component whatever, the opportunity cost of leisure is not the current market wage minus UI benefits, instead it is the current money wage plus the increase in future money wages due to current on-the-job training minus unemployment insurance benefits receivable. Since on-the-job training has always been recognized as a primary determinant of personal earnings,** this is a serious omission from any reasonable model of labour market behaviour.

In one sense, one can view the defects of the one period labour/leisure model as creating "errors in variables" and potentially biased estimates of the determinants of labour supply. Typically the dependent variable used in econometric analysis of labour supply behaviour is annual hours of work - - which is arithmetically equal to average hours per day multiplied by average days per week multiplied by weeks of work per year. If one uses annual hours of work as a dependent variable, one is implicitly assuming that the source of any variation in annual hours (i.e., hours per day, days per week, or weeks per year) is of no relevance. Although one could work 800 hours in a year either by working two eight hour days per week for 50 weeks or by working 3.2 hours per day five days a week for fifty weeks or by working 8 hours a day five days a week for twenty weeks and then being unemployed for seven months, there is considerable evidence

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**The classic reference is Mincer (1974). In addition, unemployment this year may imply loss of seniority or the creation of an unstable work history that makes it more probable that an individual will be involuntarily unemployed in future.

that individuals are not indifferent between these alternatives (see Hanoch (1980)). Weeks per year, hours per week and hours per day are imperfect substitutes - - one explanation of which is the "lump sum" costs of commuting which individuals bear regardless of the hours per day spent at a work site. As the Smith and Stelcner (1985) results illustrate (see Table 3.2) a labour supply equation which uses as a dependent variable weeks per year can produce substantially different results than labour supply equation using as a dependent variable hours per year.

As outlined above, from a human capital point of view the current money wage in one period analysis is a misspecification of the net wage. Any misspecification of the wage used in a labour supply model will entail a biased estimate of the uncompensated wage elasticity. Census data which records hours of work by intervals, implies that the hourly wage is obtained by dividing annual earnings by estimated hours of work, hence a "division bias" can also arise since hourly wages are seldom observed directly. Even when researchers have the option of asking for information on hourly wages directly, there is a considerable discussion in the literature as to whether they should focus on the wage of the marginal hour of work (i.e., including overtime premia which may be applicable) or on the average wage per hour or on the average wage per hour including the value of fringe benefits.**

**For a discussion of the difficulties, in concept and in practice, involved in measuring "the wage" see Killingsworth

In addition, although the empirical importance of non-monetary returns to employment or "compensating differentials" is widely recognized (see Lucas (1979) or Smith (1979)) there is no attempt, in the literature, to estimate anything remotely approaching a elasticity of labour supply with respect to the total or 'psychic' wage (i.e., money wage plus or minus any 'compensating differential') since it is very unclear how this could be done. Finally, as Heckman (1983) has argued forcefully, the Hausman approach to modelling the impact of taxation on labour supply requires the researcher to specify the "virtual" income and proportional tax rate which approximates the actual income tax situation of an individual - - thereby assuming that the researcher can specify accurately both the fine detail of tax treatment of a particular individual and the effective tax treatment, after any tax avoidance measures, that an individual faces.

There are thus substantial grounds, within a "neo-classical" research persective, for doubting that the hourly wage and labour supply variables in current "one period" models of labour supply are correctly specified. If the uncompensated wage elasticity of labour supply is not correctly estimated, there will be a corresponding error in the compensated wage elasticity of labour supply. The problem is accentuated when, as in Hausman (1983) Zabalza (1983) or Stelcner and Smith (1985) the researcher

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(1983 pp. 83-97.

specifies a particular form of the utility function as part of his estimation procedure, since empirical results then become contingent on the (non-refutable) specification of the utility function.**

Rather than thinnking of individuals as people who adjust their annual hours of work, and nothing else, in response to policy changes, it is more reasonable to think of individuals as having both short-run and long-run responses to policy changes and as adjusting their behaviour on a number of margins (savings, hours of work, human capital formation) in response to changes in social policy. In order to get useful results from a micro-simulation model fairly early in the process, one inevitably has to start with a crude picture of behavioural response. But later versions can improve the focus.

4.2.1. Alternative Critiques

The most fundamental criticism of the labour/leisure model is that workers, in practice, do not have an unconstrained choice of hours of labour supply at a given wage rate. As Marshall argued many years ago, demand and supply are like two blades of a scissor, and market outcomes cannot be explained solely in terms

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**Although it is correct to emphasize that the functional form of any hours/wages relationship in a labour supply model implicitly entails a set of assumptions on the utility functions of individuals, it is a much stronger assumption to select one specific utility function from the set of utility functions compatible with a particular functional form of the labour supply equation.

of one or the other. However, in the labour/leisure model, the labour demand curve facing any individual is simply assumed to be perfectly elastic at a wage rate which reflects their marginal productivity i.e., it is assumed individuals have no problem in locating as much work as they desire and supply alone is discussed.

There is by now a considerable literature on the theoretical importance of rationing or quantity constraints on labour supply to the functional form used for labour supply and quantity demand functions.** Ashenfelter (1980) has argued that unemployment should be seen as a constraint on the individual supply of labour and has tested the hypothesis with aggregate data. Ham (1982) has used micro data to demonstrate the importance of underemployment, employment, and strike activity in the hours of labour of individual workers. Osberg (1986b) is one among the many authors who have emphasized the role of layoffs in determining the incidence and duration of unemployment. If unemployment is largely due to "demand side" influences the implications is that annual hours of work are not entirely to be seen as due to individual utility maximizing decisions regarding labour supply. In econometric terms, labour supply equations which do not control in any way for labour demand will suffer from an omitted variables bias, and, therefore, will have biased estimates of the determinants of labour supply.**

**See Deaton and Muellbauer (1981) or Neary and Roberts (1980).
**Note that the Nakamura's 1981 and 1983 papers use a

It is, for example, quite conceivable that the goods and service sectors may demonstrate different responses to increases in output - e.g., the service sector may increase the number of part-time personnel while the goods sector may increase the number of over time hours. If the labour market as a whole is examined, these differences will be missed, yet they may be of interest (e.g., because increased part-time emloyment decreases the unemployment rate while increased over-time hours do not).

The 'segmentation' literature argues that behavioural relationships differ in different segments of the labour market. (For a survey see Wilkinson (1981).) Baffoe-Bonnie (1985) found evidence of structural dissimilarities in labour supply equations in different labour market segments, while Osberg et al (1986a,b) have tested the hypotheses that the same econometric specification explains wage determination, job mobility and unemployment in different labour market segments. In each case they conclude that one must reject the hypothesis of a common econometric structure and accept the hypothesis of different behavioural relationships in different employment segments.

For a behavioural micro-simulation model, the main implication at this stage is that one should retain in the data base as much information as possible on the industrial and other characteristics of employers. At a later date, it will be

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cross-section of observations (thereby controlling for cyclical variations in labour demand) and proxies for regional variations in labour demand for women.

possible to split the sample and to specify different behavioural responses for individuals in different labour market segments. In the longer term, the size of labour market segments responds to policy initiatives (e.g., the tax treatment of service industries) and one may wish to build in a more explicit "demand side" to the model.

5. Alternatives and Long Run Modelling Strategies

The advantages of using an income/leisure one period choice framework to model the behavioural responses of the Canadian population stimulation project are: (a) this framework is well grounded in mainstream neo-classical economic theory; (b) since most existing policies can be thought of as having both income and wage effects, it offers a comprehensive framework for analysis and (c) it is flexible, since new policy initiatives need only be presented in terms of their total income and net wage impacts. A final advantage of the income/leisure framework is that its very simplicity renders transparent the impacts of using alternative assumptions -- observers who dislike the suggested elasicities of table 3.3 can simply substitute their preferred choices from tables 3.1 and 3.2, and run the microsimulation model with these replacements. More complex methodologies are much less susceptible to this sort of user intervention.

However, it is perhaps already apparent that I think that there are long term disadvantages to using the one period

income/leisure choice framework. The most important, of course, is that it may not predict behaviour very well, as in the case of the reforms to the Aid to Families with Dependent Children program in the United States discussed in section 4.1. In addition, policies which essentially involve bureaucratic intervention, such as increased monitoring of claims for unemployment insurance or labour market counselling in Canada Employment and Immigration, are difficult to model within the income/leisure framework. This framework adapts poorly to policies, or economic events, which impose quantity limitations on individual economic agents since it assumes that individuals adjust quantities in response to the incentives of relative prices. Finally, a realistic socio-economic microsimulation model should have some way of building in the sociological differences that people perceive between different government programmes -- the social stigma attached to receiving a dollar from unemployment insurance, or from the welfare department, or from interest payments on Canada Savings Bonds are not identical and people in fact behave differently as a result, although these income sources are assumed to be identical in behavioural impact if one only analyzes only their income and substitution effects.

A more eclectic approach would combine the insights available from detailed studies of program implementation with the use of an income/leisure framework where such data is unavailable. To take an example from recent work on the unemployment insurance system, one can consider the modelling of

the impact of changes in the benefit/wage ratio and changes in the duration of benefits for which claimants are eligible. Rea and Ham (1985) have recently reported that the replacement ratio, the ratio of unemployment insurance benefits to wages, was not statistically significant as a determinant of the length of an unemployment claim. They argue that this result is due to "the lack of sufficient variation in the benefits over the sample period and the lack of good wage data" (1985:52).** Rea and Ham conclude (1985:53) "the benefit rate effect is still an open question as far as the Canadian data are concerned". Similarly Atkinson et al (1984) have emphasized the non-robustness of the benefit/wage effect to alternative reasonable measurements of the unemployment insurance benefit available to individuals and their offered wage. Osberg et al (1986b) have argued that the coefficient on the benefit/wage ratio becomes statistically insignificant when employer characteristics are controlled for. On the other side of the controversy, the MacDonald Royal Commission concluded that the issue was clear-cut (see Cousineau, 1985).

However, the benefit/wage ratio is only one of the parameters of the unemployment insurance system, and one may

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**In the unemployment insurance commission microdata used by Rea and Ham annual earnings were unavailable if an individual's earnings exceeded the maximum insurable earnings for that year (i.e., for most male workers). In imputing a wage to workers Rea and Ham did not have available such key variables as education or actual work experience and made no correction for any correlation between unemployment experience and offered wages. Their wage variable is, therefore, certainly highly suspect.

agree on the impacts of other parameters of the unemployment insurance system, while agreeing to disagree on the importance of the benefit/wage ratio or of such related issues as the applicability of search theory as a predictor of unemployment. Rea and Ham do have data available on the duration of unemployment insurance claims and on the maximum claim period to which individuals were entitled, both before and after the amendments of 1977. Using their data on unemployment insurance claimants over the period 1975 to 1980 they conclude "an increase in entitlement of one week increases the expected duration of unemployment by .29 weeks for men and .43 weeks for women. The effect of entitlement was very robust to changes in the specification of the equations and was always statistically significant, suggesing that one can have a certain degree of confidence in these estimates (1985:59).** An eclectic approach to microsimulation modelling would use the entitlement result, whether or not the benfit/wage finding was believed. One could easily build a microsimulation model in modules, some of which use specific empirical findings (like the relationship between unemployment duration and claims entitlement) while another

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**Strictly speaking, one ought not to try to claim that there are errors in variables which account for the "failure" of one variable (the benefit/wage ratio) and <u>also</u> claim that results from the same regression, containing a variable "known" to be misspecified can be trusted as estimates of another coefficient in the same regression. Alternatively, if the benefit/wage ratio is not misspecified in Rea and Ham's work then the insignificance of its coefficient would represent a test of the hypothesis that unemployment can be modelled as a search process.

module uses presumed income and substitution effects, together with a net wage, net income characterization of policy initiatives to predict behavioural responses to other policy initiatives.

The choice of which way to model the impact of length of claim entitlement on unemployment duration depends heavily on the expense of alternative methodologies. The quick, dirty and cheap method of estimating the impact of an increase or decrease in the length of claim entitlement would be to see it as altering the length of line segments GC and EF, i.e., has having a 'wealth effect' on the labour supply of those individuals now on (approximately) line segment FG in figure 3.6**. If one used the assumption that the impact on unemployment of a change in "unemployment insurance wealth" would be identical to the impact on labour supply of a change in wealth, then the income elasticity of labour supply could be used to estimate the impacts of a change in the entitlement formula on expected duration of unemployment. The advantage of this methodology would be that a relatively small amount of programming time, plus the maintained hypothesis of particular values for income and substitution elasticities, would produce a fairly quick estimate of the impact

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**The impact of any other change in the entitlement formula would vary across individuals in the population, since those who have always been employed would have no change in total benefit entitlement, while those with an unstable work history would be affected to a greater or less degree by any change in the number of weeks of claim entitlement per week of contributory employment.

of changes in the entitlement formula on unemployment duration. The longer and more expensive route is to examine directly the impact of changes in the entitlement duration formula on unemployment duration using the historical evidence -- but this requires a fairly comprehensive study of the sort carried out by Rea and Ham (1985).

One can probably anticipate that user demands on a microsimulation model of socio-economic behaviour will come in a variety of formats and with widely varying degrees of urgency. Some users may have fairly vague specifications of desired policy** simulations and be willing to accept a fairly long lead time before receiving an answer. Other users may ask for a simulation of the impacts of a very specific legislation change, by tomorrow. This diversity in user demands suggests that a microsimulation model might profitably adopt a two track

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**Another example would be the impacts of social security and pension benefits on the employment behaviour and retirements plans of the elderly and near elderly. See for example H.J. Aaron (1982), Aaron and Burtless (1984), Burkhauser and Turner (1981)). A convenient way of analyzing proposed changes in pension legislation is to compute the net actuarial benefit implied by proposed changes for each individual and apply an assumed parameter, representing either labour supply elasticity or savings elasticity depending on the issue, to this calculated increment in net wealth. Such a methodology begs the question as to whether individuals understand the full complexity of pension legislation and relies as well on the assumption that individuals are indifferent between all actuarially equivalent changes to pension legislation. These assumptions are certainly highly questionable, but they are convenient since the actual calculation of behavioural responses to specific parameter changes is limited by historical experience in program innovation and by the availability of research time to estimate the behavioural responses.

strategy. A better answer may be obtained with time, research effort and a detailed evaluation of any similar program alterations that have occurred in the past. A "quick and dirty" answer can be obtained in a very short period of time using the income/leisure choice framework. Given the constraints of the policy process, it would probably be desirable to satisfy both sorts of demands. However, in my view it would be a mistake to allow users to become too habituated to easy and quick answers. Rather I would argue that Statistics Canada should have a "pricing policy" which is the reverse of short run marginal cost pricing. Instead of charging relatively little for a "quick and dirty" application of the simple income/leisure framework, rather I would argue that Statistics Canada should demand a very high price for performing such simulation runs and use the revenue to "purpose build" additional modules of the simulation model behavioural response into the microsimulation model.**

**It could also be a condition of sale of a "quickie" simulation based on the one period income/leisure framework that the user be willing to accept a more sophisticated and more reliable ultimate simulation of the impacts of the policy change.

Bibliography

H.J. Aaron (1982) Economic Effects of Social Security, Studies of Government Finance, The Brookings Institute, Washington, D.C. (1982).

H.J. Aaron and G. Burtless (ed) (1984) Retirement and Economic Behaviour Studies of Social Economics, The Brookings Institution, Washington, D.C., 1984.

O. Ashenfelter (1980) "Unemployment as Disequilibrium in a Model of Aggregate Labour Supply" Econometrica Vol. 48, No. 3, April 1980, pp. 547-564.

Atkinson, A.B. et al, Unemployment Benefit, Deviation and Incentives - Britain: How Robust is the Evidence?

A.S. Blinder, R.H. Gordon and D.E. Weiss (1981) Rhetoric and Reality Journal of Public Economics, Feb/March 1984, 23(1/2) pp. 3-26. in Social Security Analysis -- a Rejoinder, National Tax Journal Vol. XXXIV, pp. 373-478.

N.S. Blomquist (1985) Labour Supply in a Two-Period Model: the Effect of a Non-Linear Progressive Income Tax Review of Economic Studies Vol. LII, pp. 515-524, 1985.

N.S. Blomquist (1983) The Effect of Income Taxation on the Labour Supply of Married Men in Sweden Journal of Public Economics Vol. 22, (1983) pp. 169-197.

R.V. Burkhauser and J. Turner (1981) "Can Twenty Five Million Americans Be Wrong? -- A Response to Blinder, Gordon and Weiss" National Tax Journal Vol. XXXIV, pp. 467-472.

R. Blundell & Ian Walker (1982) Modelling the Joint Determination

of Household Labour Supplies and Commodity Demands The Economic Journal Vol. 92 (June 1982) pp. 351-364.

C.V. Brown (ed) (1981) Taxation and Labour Supply London George Allen and Unwin (1981).

M. Browning (1985), A. Deaton and M. Irish, A Profitable Approach to Labour Supply and Commodity Demands Over the Life Cycle Econometrica Vol. 53, May 1985, No. 3, pp. 503-535.

J.M. Cousineau (1985) Unemployment Insurance and Labor Market Adjustments, Pp. 187-214 in Vol. I of Research Studies of the Royal Commission on the Economic Union and Development Prospects for Canada.

F. Vaillancourt (ed.) Income Distribution and Economic Security in Canada U. of Toronto Press, 1985.

S. Danziger, R. Haveman & R. Plotnick (1981b) "How Income Transfers Affect Work, Savings and the Income Distribution", Journal of Economic Literature, Volume 19, Number 3, September 1981, pp. 975-1064.

A. Deaton & J. Muellbauer (1981) "Functional Forms for Labour Supply and Commodity Demands with and without Quantity Restrictions" Econometrica Vol. 49, No. 6, November 1981, pp. 1521-1532.

J. Eaton and R.E. Quandt (1983) A Model of Rationing and Labour Supply: Theory and Estimation Economica August 1983, pp. 221-233.

Focus (1985) Measuring the Effects of the Reagan Welfare Changes on the Work Effort and Well-Being of Single Parents Vol. 8,

No. 1, Spring 1985.

M. Feldstein (1983) Editor, Behavioural Similation Methods in Tax Policy Analysis, University of Chicago Press, Chicago & London, 1983.

B. Fortin, H.P. Rousseau and P. Fortin (1984) Economic Evaluation of the Options in the White Paper on the Personal Tax and Transfer System: A General Equilibrium Approach, Report submitted to the Ministry of Finance, Quebec, Groupe de Recherche en Politique Economique, Economics Department, Laval University.

K.W. Glaister, A. McClure & D.T. Ulph (1981) 'Labour Supply Responses to Tax Changes: A Simulation Exercise for the U.K.", Ch. 2 in C.V. Brown (ed).

G. Glenday & J. Alam (1982) The Labour Market Experience of Individuals: Unemployment Insurance and Regional Effects, mimeo, Ottawa, 1982.

M. Gunderson (1983) Economics of Poverty and Income Distribution, Butterworth & Co., Toronto, 1983.

J. Gwartney & R. Stroup (1983) Labour Supply and Tax Rates: A Correction of the Record American Economic Review June 1983, pp. 440-446.

J.C. Ham (1982) Estimation of a Labour Supply Model with Censoring Due to Unemployment and Underemployment Review of Economic Studies (1982) Vol. XLIX, pp. 335-354.

G. Hanoch (1980) "Hours and Weeks in the Theory of Labour Supply" pp. 119-165 in J.P. Smith (ed.) 1980.

J.A. Hausman (1983) "Stochastic Problems in the Assimulation of Labour Supply", pp. 47-69 in M.J. Feldstein (ed.) 1983.

J. Heckman "Sample Selection Bias as a Specification Error" pp. 206-248 in J.P. Smith (1980) (ed.).

Hills, S.M. Estimating the Relationship Between Unemployment Compensation and the Duration of Unemployment - The Problems of Eligible Non-filers, Journal of Human Resources Summer 1982, 17(3), pp. 400-70.

R.A. Ippolito (1985) "Income Tax Policy and Lifetime Labor Supply" Journal of Public Economics Vol. 26, No. 3, April 1985, Pp. 327-348.

G.V. Jump and S.A. Rea (1975) The Impact of the 1971 Unemployment Insurance Act on Work Incentives and the Aggregate Labour Market: A Report Submitted to the Unemployment Insurance Commission, Institute for the Quantitative Analysis of Social and Economic Policy, University of Toronto, February 28, 1975.

M. Keeley (1981) Labor Supply and Public Policy: A Critical Review N.Y. Academic Press.

J.R. Kesselman (1986) The Royal Commission's Proposals for Income

M.R. Killingsworth (1983) Labour Supply Cambridge Surveys of Economic Security Reform Canadian Public Policy Feb. 1986, P. 101-112. Literature, Cambridge University Press, 1983, Cambridge.

T.E. Macurdy (1983) A Simple Scheme for Estimating an Intertemporal Model of Labour Supply and Consumption in the

Presence of Taxes and Uncertainty International Economic Review, June 1983, Vol. 24, No. 2, pp. 265-290.

R.L. Mazany (1985) "Married Women's Labour Force Participation and Fertility Decisions" Dalhousie University, Working Paper #85-05.

R.E.B. Lucas (1977) "Hedonic Wage Equations and Psychic Wages in the Returns to Schooling" The American Economic Review September, 1977, pp. 549-558.

J. Mincer (1974) Schooling Experience and Earnings, National Bureau of Economic Research, New York, 1974.

R. Moffitt (1985a) Assessing the Effects of the 1981 Federal AFDC Legislation on the Work Effort Heading Households: A Framework for Analysis and the Evidence To-Date Journal of Policy Analysis and Management, Summer 1985, (forthcoming).

A. Nakamura & M. Nakamura (1981) A Comparison of the Labour Force Behaviour of Married Women in the United States and Canada with Special Attention to the Impact of Income Taxes Econometrica Vol. 149, No. 2, March 1981, pp. 451-490.

A. Nakamura and M. Nakamura (1983) "Part-time and Full-time Work Behaviour of Married Women: A Model with a Doubly Truncated Dependent Variable" Canadian Journal of Economics Vol. 16, pp. 229-257.

J.P. Neary and K.W.S. Roberts (1980) "The Theory of Household Behaviour under Rationing" European Economic Review Vol. 13, Pp. 25-42, 1980.

Orcutt, G.S. Caldwell & R. Wertheimer (1976). Policy Exploration

Through Micro-Analytic Simulation, Washington, D.C., The Urban Institute.

L. Osberg (1981) Economic Inequality in Canada Butterworths Toronto 1981.

L. Osberg, L. Mazany, R. Apostle and D. Clairmont (1986a) 'Job Mobility Wage Determination and Segmentation in the Presence of Sample Selection Bias' forthcoming Canadian Journal of Economics, May 1986.

L. Osberg (1986b) The Incidence and Duration of Individual Unemployment: Supply Side or Demand Side? Forthcoming Cambridge Journal of Economics.

L. Osberg (1986c) Economic Theory and Unemployment, An Essay on Constraints, Choices and Blind Spots, A Report to the Commission of Inquiry on Unemployment Insurance, March 1986.

S. Phipps (forthcoming) "An Ethically Flexible Evaluation of Unemployment Insurance in Canada", Ph.D. dissertation (in progress), University of British Columbia.

C.A. Pissarides (1983) Efficiency Aspects of the Financing of Unemployment Insurance and Other Government Expenditure Review of Economic Studies Vol. L, 1983, pp. 57-69.

S.A. Rea (1985) Unemployment Insurance and the Labour Market Strategic Policy and Planning, Unemployment Insurance Analysis Directorate Employment and Immigration Canada, January 31, 1985.

S.A. Rea and J. Ham (1985) Unemployment Insurance and the Labour Market Strategic Policy and Planning U.I. Analysis

Directorate, Employment and Immigration Canada January 31, 1985.

S.A. Rea (1977) 'Unemployment Insurance and Labor Supply: A Simulation of the 1971 Unemployment Insurance Act' Canadian Journal of Economics Vol. 10, No. 2, May 1977, pp. 263-278.

C. Robinson & N. Tomes (1985) More on the Labour Supply of Canadian Women Canadian Journal of Economics Vol. XVIII, No. 1, Feb. 1985, pp. 156-163.

D.F. Rose & J.G. Selody (1985) The Structure of the Small Annual Model Bank of Canada Technical Report No. 90, Ottawa, May 1985.

M. Stelcner and J.B. Smith (1985) "Labour Supply of Married Women in Canada: Non-Convex Budget Constraints and the CES Utility Function" Concordia University, Dept. of Economics Working Paper #1985-09.

J.B. Smith and M. Stelcner (1985) Labour Supply of Married Women in Canada, 1980, Working Paper No. 1985-7, Concordia University, Department of Economics.

J.P. Smith, 'Family Labour Supply over the Life Cycle' Explorations in Economic Research NBER, Vol. 4, B Spring, 1978.

R.S. Smith (1979) "Compensating Wage Differentials and the Public Policy" A Review Industrial and Labour Relations Review April 1979, p. 339.

James P. Smith (1980) Female Labour Supply: Theory and Estimation, Princton University Press, Princton, New Jersey,

1980.

R. Strotz (1956) "Myopia and Inconsistency in Dynamic Utility Maximization" Review of Economic Studies 1956.

F. Wilkinson (ed.) 981 The Dynamics of Labour Market Segmentation Academic Press, London 1981.

T.J. Wales & A.D. Woodland (1979) Labour Supply and Progressive Taxes Review of Economic Studies 1979, pp. 83-95.

M. Wolfson (1985) "On the Distributional Impacts of a Guaranteed Income for Canada"

A. Zabalza (1983) "The CES Utility Function, Non-Linearity Budget Choices Sept. 1985, The Institute for Research on Public Policy. Constraints and Labour Supply. Results on Female Participation in Hours" Economic Journal Vol. 93, 1983, pp. 312-330.

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